THE

ELECTRICAL REVIEW.

VOL. XXXIII. NOVEMBER 3, 1893. No. 832

CONTENTS:

	PAGE
Cable and Electric Railways	463
The New System of Alternating Current and Transformer Distribution.—II. (*illustrated*)	465
The Action of Continuous and Alternating Currents on Alloys for Fuse Wire (*illustrated*)	466
The City and Guilds of London Institute	468
Utilisation of Waste Heat (*illustrated*)	469
Researches on Electrical Wave Interference	470
Report on Epstein Accumulators	471
A Double Filament Incandescent Lamp (*illustrated*)	471
The Development and Transmission of Power from Central Stations.—V.	472
Legal:—Wilkinson *v.* Medical Battery Company	474
Wagstaff *v.* The Edison-Bell Phonograph Corporation	474
St. James's and Pall Mall Electric Light Company	474
Correspondence:—Arc Lighting.—Incandescent Lamps	475
Pumping by Electricity.—What is Lithanode?	475
Electrical Education	476
Lighting Express Railway Service	476
The Neutralisation of Self-Induction by Capacity	478
Notes	479
Contracts Open and Closed	481
Business Notices	482
City Notes:—Montevideo Telephone Company	483
International Okonite Company	484
The Continental Edison Company	484
Eastern Extension Telegraph Company	484
Traffic Receipts	484
Share List of Electrical Companies	485
Fluid Fuel	486
American Electro-Therapeutic Association (*continued*)	486
The Interrupted Atlantic Cables	488
New Patents	489
Abstracts of Published Specifications	489

THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).
ORDER AT ONCE

PRICE 4/- POST FREE.
The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

FOR THE 1894 ISSUE.

PRICE 4/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of commercial Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,
22, Paternoster Row, London, E.C.

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. Established 1872.
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address "AGRERAY, LONDON." Code A B C. Telephone No. 517

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free, per Year, 19s. 6d. To all *Foreign Countries* (except those mentioned below), per Year, £1 1s. 6d. *Exceptions.*—Abyssinia, Aden, Borneo, Ceylon, India, Java, Labuan, Mozambique, Penang, Persia (*viâ* Brindisi), Phillipine Islands, Singapore, Zanzibar, to which the rates are: per Year, £1 8s, 10d.

BINDING.—Subscribers' numbers bound, including case, for 3s. 6d. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 22, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 22, Paternoster Row, E.C.

CABLE AND ELECTRIC RAILWAYS.

IN considering the comparative cost of working cable and electric railways in England, we are confronted with the difficulty of an insufficiency of data. This arises from the fact that few are established, and that they usually form part of some larger tramway system which results in the cost of working being mixed up with the accounts of other parts of the line. The *Railway World*, however, has attempted, and with considerable success, to analyse the various tramway accounts, and in the last issue presents some exceedingly useful figures as to the cost of cable and electric haulage. We are assured that they are absolutely trustworthy, and that being so, one is helped to arrive at certain definite conclusions. It must be pointed out, however, that no comparison can be quite successful which does not include the working of the trolley system on the South Staffordshire and the Leeds tramways. We expect that considerable time must elapse before the actual expenses incurred in the first-mentioned case are known. The contractors work the line at a certain fixed sum. We opine they would be in no hurry to publish unfavourable returns; not that we would suggest that because figures are not available the line is necessarily being worked at a loss, evidence rather points the other way. But, generally speaking, such a method of running a system precludes the publication of accurate tables of expenditure. Fortunately, with the two largest applications of electricity for traction purposes, there is no necessity to retain as a cherished secret the cost per tram or car mile. While a little outside our province, it is interesting to note that the English plan of laying cable roads is apparently superior to the American method, and is certainly less expensive; therefore electric traction will have more to compete against in England than it has had to do in America, providing it is necessary to bring the two systems into open competition, which we very much doubt. The Edinburgh system of cable traction is one of the oldest in Great Britain, and one of the most efficient in the world; the cost of the motive power per car mile is 1·1d., traffic expenses are returned as 2·66d., the total being a little over 6d. per mile. We might add that these figures are the average for the past three years. It must be admitted that this is an extraordinary low cost, and could not be challenged by either steam or electricity. Another point to be remembered is that no other system of motive power would have had a ghost of success in dealing with the severe gradients that abound in the New Town of Edinburgh. One almost hesitates, spite of contingent advantages, to put this phenomenal figure alongside the working expenses of an electric line. Let us take, say, the City and South London line—the Liverpool Overhead, for purposes of comparison, must be left out of account—we almost blush to find that the total cost per mile is 16d. We are still left some crumbs of comfort when we contemplate that the expenses have been

reduced to the extent of 3d. per mile; still more are we inspired with hope when we take into consideration that the receipts per car mile on the City Railway are twice those usually obtained on a cable system. The City Railway, although it fulfils little more than the duties of a tramway, labours under the disadvantage of having to pay for the cost of the usual railway administration, such as porters, station masters, signalmen, and all the other equipment which distinguishes a railway from a tramline. We are tempted to supplement the figures given by our contemporary by showing that the loco. and generating expenses on the City and South London are returned as 6·48d., and 4d. on the Liverpool Overhead Railway, while the passenger earnings on the respective lines are 24·7d. and 26·6d. This bears a most favourable comparison with railways pure and simple, and can compare fairly well with cable traction. As we have already pointed out, however, there is no means of knowing whether the cost per mile in the case of the Overhead Railway really represents the true state of affairs; for like the South Staffordshire tramways, the contractors undertake to work the system at a fixed charge of 4d. per train mile. There is a point in connection with the use of electricity which has hitherto appealed with great force to the mind of the tramway engineer, and that is, though electric tramways work cheaply at first, the maintenance bill goes up alarmingly as years pass. The spirit of exaggeration has clearly been abroad, and we may attribute this fear partly to the unsuccessful attempts made with accumulator cars at Birmingham during the past few years; but we have reason to think that this failure bids fair to be remedied by accumulated experience and increased efficiency of storage batteries. It cannot be denied that on many American electric railways the expenses have at times reached an extraordinary figure, attributable in a great measure to the abnormal expenses occasioned by faulty earth returns. We hope, however, before traction becomes general in England, to have arrived at some efficient and lasting return circuit, and thus avoid what has been in the States a constant source of trouble and expense. There seems to be little doubt that tramway men, both engineers and directors, have a decided leaning towards accumulator cars, though they hesitate at present to commit themselves outright. They have watched the progress of events at Birmingham with the greatest interest, noted with the keenest criticism the repeated failures, until one would have thought they were completely convinced of the inadequacy of storage batteries for traction purposes. Again, however, the Birmingham Central Tramways Company are making spirited efforts to prove the utility of accumulators, and their success will have a marked effect on the future of accumulator traction. They are gradually displacing the older type of cells, and they are hopeful of accomplishing much by the new accumulator. We have every reason to think that the prospects of success are bright. Our conviction of the qualities of this cell has come to us from actual tests. These results, which, by the way, are published in this issue, have caused, in certain quarters, annoyance which is as unreasonable as it is foolish. It cannot be denied that the record of the accumulator car at Birmingham is a dismal one. In 1891 the total expenses per car mile was 9·9d., which, if maintained, might have been deemed satisfactory. Of this sum 5·15d. is returned as cost of electric haulage, 0·29d. being debited to machinery. The year 1892, however, tells a different tale, for 5·88d. is the cost of electric haulage, and 4·03d. for machinery, the total expenses being 15·39d., a loss of 2·14d. per car mile being the result. Although the first six months of the present year show still heavier expenses, the loss, owing to an increase of traffic, is considerably less. The interest which attaches to the future working of this line is great, and we trust that the sanguine expectations held out may be realised. Nothing but satisfaction must be felt with the financial condition of the Overhead Railway and the South London line. We must confess that the prospects of the latter company were anything but healthy at the commencement of their career. Traffic has, however, increased, and with the addition of the Islington line the ordinary shareholders should have no reason to be disappointed with their investment. Still greater gratification must be felt by the proprietors of the Liverpool Overhead Railway where the expenses are slightly lower and the receipts a little higher. We are inclined to agree with our railway contemporary that the prospects of electricity as a motive power are distinctly good, and there is ample justification for the establishment of new lines. At the same time, in spite of the good showing of cable lines, we are naturally inclined to pin our faith more to electricity than to cables, though we have admitted that under certain conditions no other power could show the remarkable results that cable lines have attained.

High Frequency Discharges and Glow Lamps.

IN the REVIEW for October 13th we gave extracts from an article in the September number of the *Phil. Mag.* by Mr. Campbell-Swinton. In it he gives another explanation of the lighting of a 5 C.P. 100-volt glow lamp by high frequency discharges, which was suggested to him by the Hon. C. A. Parsons. The principle of it is that since the heat developed varies as the square of the current, while the quantity passing is proportional to the current, and as the current, from the nature of the apparatus, can only pass in short impulses (between which there are intervals of no current which are long in comparison), the heat developed in the lamp may be the same as when taking its normal current of ·2 ampère at 100 volts continuously, while the average current will be very much less. Of course the maximum current will be very much greater than the normal current. To give a clear example of this, suppose the resistance of the lamp remains normal, viz.: 500 ohms, and the pressure at its terminals is 10,000 volts, then the current through it will be 20 ampères. Suppose, moreover, that the current rises instantaneously to this value, remains constant at it for a certain fraction, f, of the total time, t, and then instantaneously falls to zero (of course this cannot be exactly the case, since the current must rise and fall more or less gradually). The energy developed in the time, t,

$$= 20^2 \times f \times t \times \text{R} = \cdot 2^2 \times \text{R} \times t,$$

since this latter represents the energy required when the current is constant. Hence, $f = \frac{1}{10000}$, or the current interval is only ·0001 of the interval of no current. In one second we have, therefore, 20 × ·0001, or ·002 of a coulomb, passing through the lamp, this is equivalent to an average current of ·002 ampères, or $\frac{1}{100}$th of its normal current. The objection to this theory seems to be that when the lamp is lit through the body, although the normal current would be small, the maximum current through it would be large, and, as far as our knowledge goes of intermittent discharges, the shock does not depend on the average but on the maximum current. It is of course possible that when the frequency of the intermittences is very high, the shocking effects may not thus depend on the maximum current; but in Mr. Swinton's apparatus, although the oscillations proper may be of the order of millions, the intervals at which each set of oscillations occurs are of the same order as the frequency of the contact breaker on the induction coil charging the jars.

THE NEW SYSTEM OF ALTERNATING CURRENT AND TRANSFORMER DISTRIBUTION.

By RANKIN KENNEDY.

II.

QUADRATURE GENERATORS.

As already described, quadrature currents commutated into a practically continuous current were very early in the history of dynamo-electric generators produced by several inventors. In more modern instances we find this idea of producing continuous currents from quadrature currents, and we cannot do better than refer to Prof. S. P. Thompson's "Dynamo-Electric Machinery," published in 1884, page 25, in which he says: "To give continuity to the currents we must advance from the simple two-part commutator to a form having a larger number of parts and employ therewith a larger number of coils. The coils must also be so arranged that one set comes into action while the other set is going out of action. Accordingly, if we fix on our armature two sets of coils, *at right angles to each other, so that one comes into the position of best action, while the other is in the position of least action* (one being normal to the lines of force when the other is parallel to them), and their actions be superposed, the result will be a current which is continuous, having four slight undulations per revolution." A further reference to pages 188 to 191, of the same work, shows clearly the fundamental two-phase or quadrature generator, fig. 148, page 190, and figs. 149 and 150, showing clearly curves of two-phase or quadrature currents, rectified and unrectified.

Now, every continuous current dynamo is a multiphase dynamo in which the currents are commutated into a continuous current. A Gramme or Hefner-Alteneck drum armature, and all other modern continuous current armatures, generate multiphase currents. An armature with 60 coils and a 60-part commutator, generates 30 currents in 30 different phases; these are converted into a continuous current by the commutator, but by suitable connections, we can obtain currents of any phase difference we may require from any continuous current dynamo, and, perhaps, the best multiphase generator for most purposes shall be an ordinary continuous current generator on which connections are made to obtain the currents of different phases. In fact, the author is convinced by direct experience, that such machines must eventually displace all others in ordinary distribution, and the reasons for this conviction will be fully set forth in treating of this class of generator. For high pressure and long distance work, however, such machines are not suitable unless worked in conjunction with step-up transformers; we shall, therefore, require to consider another class of generator of two-phase or quadrature currents specially suitable for the highest pressures.

Now, let us consider what this quadrature system consists of principally. Why do we want it? What can it do that cannot be done by the single phase current or the continuous current systems now in use? Primarily, the difference lies in the commutation of the currents generated. In all three systems the currents generated are primarily alternating currents. In the continuous current system the currents are multiphase currents to begin with, and these are commutated at, and sent from, the generators as continuous currents, but once having converted our primary multiphase currents into continuous currents, we cannot then transform them up or down in pressure, neither can we use them for apparatus requiring alternating currents, neither can we use them to work the multiphase or two-phase motors, having no brushes and no commutators. These are the objections upon which those who know multiphase currents base their convictions that multiphase are superior to continuous currents. Every continuous current system, now in operation, begins with multiphase currents, some having as many as 40 different phases; these multiphase currents are at once commutated into a continuous current and delivered as such, and this work of commutation is no trifling matter either, as the volumes that have been written about it amply testify. And the author asserts, and intends to prove, that "*thus commutating the multiphase currents and delivering them as direct continuous current, deprives the electric currents generated by the dynamo of most valuable properties.*"

The single-phase alternating systems go to the other extreme and deliver a current of one phase, just as it is generated, unshorn of any of its properties by commutation. It has the advantage over the continuous current, in that it can be transformed up and down to any extent, but that is about the only advantage we can appreciate. It does not very well work motors either with or without brushes and commutators, and a single-phase alternating current cannot work continuous current appliances. All theory and experience point towards the use of more than one alternating current for general purposes.

It is to be borne in mind that the continuous current system is limited to the use of continuous current appliances, and that transforming and high pressures are great difficulties with it, and that, on the other hand, the single-phase alternating systems are limited to single-phase appliances. And although high pressures and transforming are no difficulties, yet like the continuous current system it is limited, and, therefore, they are under the very best of circumstances only partial solutions of the distribution problems, and the general adoption of these partially prepared systems at the present moment is a great misfortune to the cause of electrical engineering progress. In a year or two's time this fact will be realised by some of the corporations and municipalities, at whose expense the continuous current and single-phase alternating current experiments are being made, and the results must prove disastrous.

Another important consideration which condemns the use of the continuous current systems of distribution, is that once the pressure is fixed and laid on, it cannot be altered to take advantage of improvements in the incandescent lamp; the pressures common now are adopted to suit a lamp made for 100 or 110 volts under a close monopoly of manufacture, but now that lamp making is practically open, there is more than a probability that improvements will raise the pressure without impairing the life of incandescent lamps to perhaps 150 or even 200 volts; such an improvement would mean a vast increase of carrying capacity in the copper mains, yet it could not be taken advantage of by the systems running now at 100 or 110 volts continuous current.

Improving the incandescent lamp to take 150 instead of 100 volts pressure, means a saving of 50 per cent. in copper in mains. This improvement could be taken advantage of by alternating current systems, both single-phase and quadruture systems.

The engineer who imagines that electrical and engineering science is to stop the march of improvement with an incandescent lamp of 100 or 110 volts as the maximum pressure, and 4 watts per candle power as the highest efficiency, must have very erroneous ideas regarding the whole subject. This 100-volt fad is another limitation on the continuous current systems.

The childish idea that we have reached finality in electrical distribution plants and systems is entertained by many engineers at present; those who do entertain such an idea are likely to get very much "left" some day not far off.

Now we want a system which is *not limited* to any particular appliances, and that system is found in a two-phase, or, as I prefer to call it, a "quadrature system" of alternate current distribution. It will do for us what neither of the other two older systems can do—it will work alternate current, continuous current, or quadrature current appliances. High pressures and transformers are no difficulties whatever.

It is a more efficient system than either of the other two, and is applicable to all kinds of districts. A city, town, or district adopting such a system is provided for against all future developments and improvements, whether in continuous or alternating current appliances, whereas, in adopting one or other of the two older systems, the march of improvement will soon leave them behind and render their plant to a considerable extent so much scrap metal. Furthermore, this quadrature system introduces no new or experimental machinery, about which there might be a doubt of its performance; the machinery required for its performance is just the same as that required for either or both of the other two old systems, only it is used in a more rational method.

The question has often been superciliously put, "What do we want alternating currents for, and what do we want multiphase currents for, when continuous currents are good enough for us?" Well, the continuous currents are good enough only for two or three purposes; it must be admitted that continuous currents are far better for arc lighting, and are

absolutely necessary for storage of electricity and other purposes, but on this quadrature system continuous current can be supplied for these purposes quite as well.

To get the highest efficiency out of any generating plant, storage must, to a large extent, be adopted and is adopted, by continuous current suppliers. It cannot be adopted by single-phase alternating current suppliers, but it can be adopted by the quadrature system to any extent. There are two methods of working storage batteries on the quadrature system, both of which shall be described.

The reader will now have an idea as to what is the difference between this new system and the others, and also as to what it proposes to accomplish; and why we want it; and what it can do that the others cannot do. We can proceed to describe how it is all to be done. I could describe, perhaps, a score of generators suitable for a quadrature system, but one will suffice of each kind, namely a low pressure machine and a high pressure machine, both of my own design, and one by Schuckert. I am better acquainted with these, and have no doubt the other designers will lose no opportunity of sending forth descriptions of other quadrature generators designed by them, or for them.

In 1891, the author designed a modification of the quadrature system, and described it in a few articles in the ELECTRICAL REVIEW. It was called a unidirection pulsating system. Out of that system he has developed his dynamos now to be described, and which are typical of all quadrature dynamos of this class, for low pressures.

Fig. 1 is a diagram of a dynamo with connections for obtaining multiphase currents. This diagram shows connections for obtaining three currents, differing in phase by

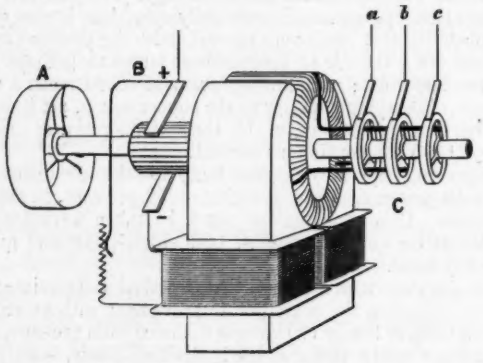

FIG. 1.

120°. For this purpose three rings, C, are fitted on the shaft, from which they are insulated, and from each other. These rings are connected to the ordinary commutator, B, to plates 120° apart; that is, on a 60-part commutator ring, A would be connected to plate No. 1, ring *b* to plate No. 20, ring C to plate No. 40. On dynamo being driven at A, we would get the ordinary continuous current at B, and the multiphase current at C, and we could take them off both at the same time without in any way interfering the one with the other. Now, if we put four rings on the shaft at *c*, and connect them to four points 90° apart on the commutator, B, that is 15 plates apart on a 60-part commutator, we get two currents in quadrature at C, and the ordinary continuous currents at B. This is the simple plan for obtaining the quadrature currents from ordinary continuous current dynamos, and upon this plan the best type of dynamo for quadrature working for many purposes is designed.

THE ACTION OF CONTINUOUS AND ALTERNATING CURRENTS ON ALLOYS FOR FUSE WIRE.

A FEW experimenters have devoted a small part of their time to the determination of the fusing current for wires of different diameters used in the trade generally for fuses. Of these the best known is Mr. Preece. But no practical result of any importance has resulted from these researches, and at the present moment the greatest uncertainty exists as to the real fusing current of small fuses.

It is recognised, vaguely, that the length of the fuse wire will, within certain limits, affect the ultimate fusing current; but these limits, and the extent to which the ultimate fusing current is thereby affected, are not accurately known. The writer is not aware of the existence of any experiments designed to show the best alloy or the best metal for small fuse wire, and the minimum length of the fuse wire, in order not to affect the fusing current.

There is so much uncertainty in the matter that anyone who seriously expects to find 5-ampère fuses correctly rated within 25 per cent. is looked upon as very simple-minded. Indeed, at the present day, engineers are beginning to employ magnetic cut-outs instead of fuses for anything over 50 ampères, while the smaller fuses, and especially fuses such as are placed in ceiling roses to protect one or two 8-C.P. lamps, are, generally speaking, of very little use as safety devices, and very often far more bother than they can ever be worth. Engineers trust more to good workmanship than to the fuses to preserve the wiring of a building from danger, but this is no valid argument why this state of uncertainty as to the action of fuses should be allowed to continue. Obviously, if a fuse is to be used at all, its action should be defined, known, and capable of proof. What would the Board of Trade say to a man who fitted his steam launch with a safety valve that would allow steam to blow off at some pressure between 70 and 150 lbs. per square inch? The writer well recollects his feelings on a recent occasion on being invited to attend a trial of a new boiler which was stoked by the inventor. Experience led to some enquiries as to the relation between the boiler and the safety valve. It transpired that the boiler was *designed* (it was quite a novel design) to stand 150 lbs. per square inch, and that the inventor did not know much about the safety valve, but thought it was "somewhere about right, approximately."

If a boiler bursts there is the usual Board of Trade enquiry. If a fuse fails to act, and so causes fire—in nine cases out of ten the fuse eventually does *fuse*—there is absolutely no evidence to be obtained on the subject after the fire has been extinguished. The writer recently found a 16 C.P. lamp protected by No. 18 fuse wire. By way of experiment he short-circuited the lamp terminals, with the result that the main fuse in the building blew, but the fuse "protecting" this particular lamp did not.

In a paper presented at the tenth general meeting of the American Institute of Electrical Engineers, Mr. C. P. Matthews has drawn attention to some points of importance, and to the results of what appear to be a long series of systematic and carefully carried out experiments on the action of continuous and alternating currents on fuses. The paper and the two theses from which it is abstracted, are well worth careful perusal. The results of abstract argument point to the fact of the fusing current being independent of the length of the wire; the results of practice show that this is very far from the case, and the obvious inference that abstract argument does not apply to practice, is perfectly legitimate. It is customary among so-called practical men to despise theoretical considerations, and to say that an ounce of practical experience is worth a pound of theory. But it is this very discrepancy between anticipated and observed results that leads to a proper comprehension of phenomena observed in practice and to the improvement of practice. It is obvious that all that is required to enable fuses to be manufactured so as to be reliable in practice, is a careful and systematic observation of unexpected points of difference and an investigation into their cause.

The most important points requiring practical determination are, (1) the minimum length of fuse wire for different carrying capacities, in which the fusing current is not affected by the cooling effect on the wire of terminals; (2) the effect of the time element on the ultimate fusing current.

From the results quoted in the paper in question, it would appear that fuse wires between 4 inches and 5 inches long, are not materially affected by conduction losses due to the terminals. The curve showing the variation of the fusing current with length of wire, all other conditions being practically the same, is worth reproducing (fig. 1). It is worth noting that a wire fusing with 6·6 ampères when 8 inches long,

allowed 12·6 ampères to pass before fusing when only a ½ inch length was used.

The determination of the effect of the "time element" upon the fusing current is a more complex matter, and the method of making provision for it in practice is even more difficult still. If we could be certain of the circumstances under which a fuse will be called upon to protect its circuit, there would be little difficulty in providing a type of fuse

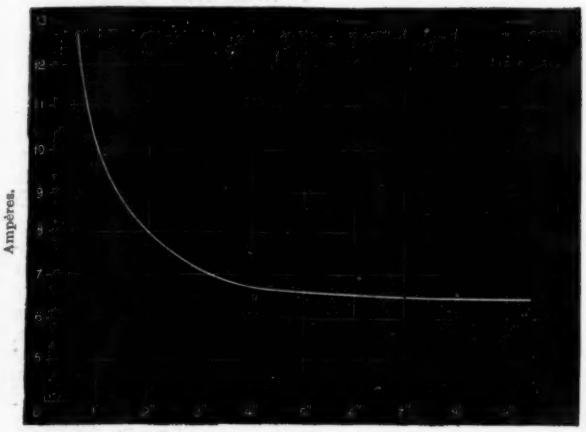

FIG. 1.

which could be depended upon to a considerable extent. But fuses are often expected to be reliable under conditions which may vary from one extreme to the other, and being obedient only to physical laws, it is unreasonable to expect their behaviour not to be influenced by varying circumstances. Mr. Matthews calls attention to the fact that at least a minute should elapse to enable the wire to reach the temperature corresponding to a definite current; experience having shown that if a wire of

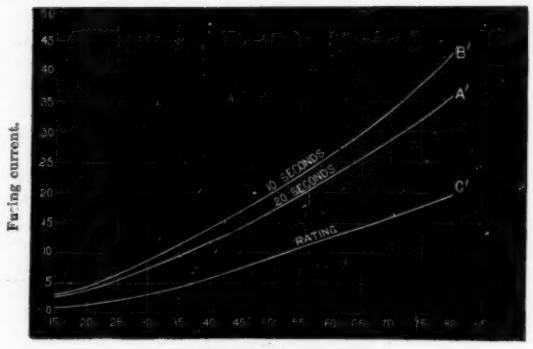

FIG. 2.

moderate diameter did not fuse in that time under the action of a certain current it would not fuse at all, and this important fact is shown in fig. 2, in which curves, A and B, indicate the magnitude of this effect, the intervals allowed being 10 seconds and 20 seconds respectively. Curve C shows

TABLE B.—DATA FOR FIG. 2.

Rating.	Diameter.	Current.	
		10 seconds.	20 seconds.
1	·0155	3·08	2·93
2	·0248	6·20	5·64
5	·0374	12·6	10·81
10	·0533	21·24	18·29
20	·0804	42·61	36·18

the fusing current as "rated." It is a pity that the author of the paper did not include in this figure a fourth curve, showing the fusing current when a 60-second interval was allowed, in order to compare with the manufacturer's rating.

An important as well as interesting result is recorded in the following diagram, fig. 3. The curve represents the current necessary to fuse a wire of unit diameter, the wire being made of various alloys of lead and tin, and the results from which the curve was drawn, are the main values of the calculated fusing current for a wire of unit diameter deduced from each observation of current and diameter. This curve enables the constant for any alloy of lead and tin, or the fusing current of a wire of any alloy and of any (reasonable) diameter to be calculated. As far as the writer can gather, these values were determined when ample time was allowed to elapse for the wire to reach the temperature due to the current passing. Obviously, in increasing the current continuously and rapidly an altogether fictitious result could be obtained.

TABLE A.

Alloys.	Per cent. lead.	a	Preece's constant.
Tin	0	1,592	1,642
Tin 2, lead 1 ...	33·3	1,441	
Tin 1, lead 1 ...	50	1,328	
Tin 1, lead 2 ...	66·6	1,156	1,318
Tin 1, lead 4 ...	80	1,131	
Lead	100	1,283	1,379

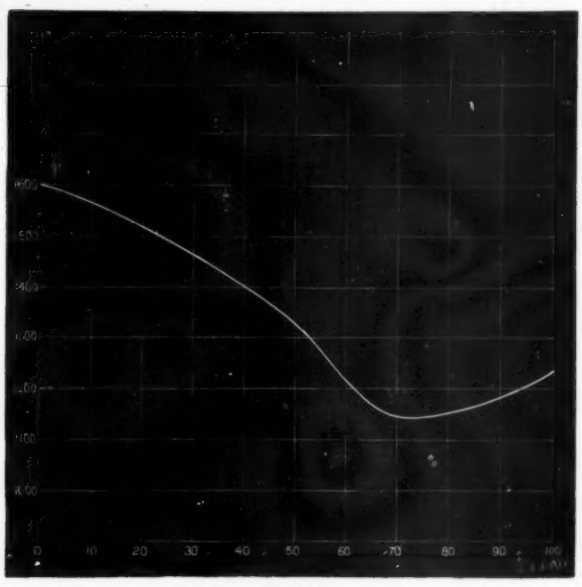

FIG. 3.

Another experiment which has an important bearing in practice is shown graphically in fig. 4. Curves A and B show the difference in behaviour of 2-inch and ½-inch pieces of the same fuse wire testing under identical conditions. Curve C

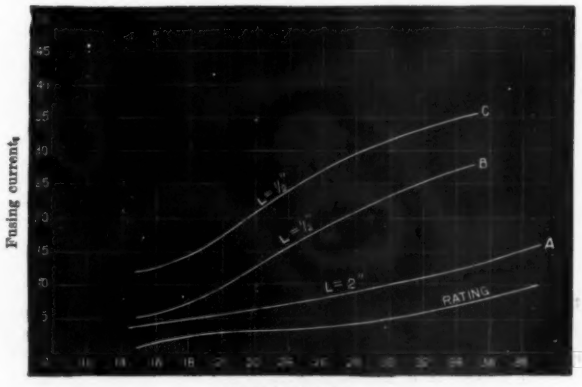

FIG. 4.

indicates the variation in the fusing current when a ½-inch length of the wire was tested in a porcelain ceiling rose, the wire being purposely depressed so that it came in contact

with the porcelain throughout its length. The fusing current is raised by 7 to 8 amperes for all diameters, owing to the conduction losses. Who has not seen fuses in ceiling roses under very similar conditions?

DATA FOR FIG. 4.

Rating.	Diameter.	2-in. piece current.	½-in. piece current.	¼-in. piece. in fuse block.
1	·0149	4	5·37	12·03
3	·020	5·72	9·9	17·68
5	·03·5	9·65	23·4	32·16
7	·0351	12·76	27·5	35·37
10	·0395	15·78		

In Part II. of this paper, Mr. Matthews gives the results of a series of most interesting investigations as to the cause of the observed variation in the resistance of fuses brought about after the lapse of time by an alternating current. Mr. Matthews has been unable to arrive at any scientifically satisfactory conclusion, but describes the following experiments as indicative of some molecular change in a fuse wire employed in an alternating circuit. He says:—

"It being practically impossible to test wires of so soft material for tensile strength, it was considered best to subject them to an alternate torsional stress of a given amount, continuing the alternations and noting the number until the specimen gave away. A simple piece of apparatus was constructed for this purpose, and it did its work very well. Twenty pieces of each of the 14 specimens were tested in this way. Ten of these had been subjected to current action, and 10 had not. The change in brittleness in the case of the fuses which had been on alternating circuits was quite marked, being in no case less than 7 per cent.; while the change in those which had been on direct circuits was, with one exception, negligible. These results together with some data on the fusing points before and after the passage of the currents are given in the subjoined table:—

EXPERIMENTS SHOWING EFFECT OF CONTINUOUS AND ALTERNATING CURRENTS ON FUSE WIRE.

No.	Rated capacity.	Fusing current.			Torsion test.			Hours run.	Per cent of change of resistance.	Nature of current.
		Before.	After.	Per cent. of change.	Before.	After.	Per cent of change.			
1	2	8·83	8·56	3·6	14·4	10·9	24	487	0·2	Alternating 250 ~
2	2	7·96	7·86	1·26	21·6	19·9	7·9	169	0·5	
3	3	12·6	12·15	3·56	14·9	13·2	11·14	487	15	
4	3	8·46	8·24	2·6	28·8	22·4	21·4	169	0·4	
5	5	17·96	17·46	2·55	21·7	18·5	14·8	170	2·2	
6	10	27·4	25·3	8·3	13·3	11·7	12	487	2·0	
7	18	52	46·4	10·8	14·8	11	26·4	209	11·3	Alternating 132 ~
8	36	52	45·4	11·9	15·2	13·6	10·5	105	29·6	
9	18	52	49·5	4·8	16·9	13·9	17·8	83	3·5	
10	10	26·8	26·8	·3	24·1	23·9	·8	170	− 2·9	Continuous.
11	18	52	51·5	9	13·3	13·7	·7	200	− 3·5	
12	18	52	51·4	1·1	13·8	12·3	10	296	− 0·1	
13	25	65·06	65·02	·061	11·1	11·0	9	300	− 2·3	
14	25	65·06	65	·092	11·4	11·3	·8	264	− 1·5	

"While these results may be considered as only a beginning along a line of work which is of both theoretical interest and practical value, yet they would seem to warrant the following conclusions:—

"(1) There is a distinct although irregular rise in the resistance of a fuse on an alternating circuit. (2) This is perhaps to be accounted for by a change in the molecular structure of the metal. (3) This results in a decided lowering of the fusing current, in some cases at least, easily sufficient to affect the reliability of the fuse."

THE CITY AND GUILDS OF LONDON INSTITUTE.

THE report of the Examinations Department of this institute states that a distinction has been made this year, for the first time, between candidates from Metropolitan and from other classes, grants on results having been discontinued in the case of the provincial classes, whilst they are still offered to classes within the Metropolitan area. In accordance with a circular letter issued by the institute in 1891 to county councils and technical schools, the withdrawal of grants to provincial classes has been accompanied by the several improvements in the machinery of the examinations referred to in that circular. Among them may be noted the closer adaptation of the syllabuses of examination to the requirements of different localities and trades by the introduction into the programme of new subjects of examination, by the division of subjects into sections following more nearly the principal branches of each trade, and by the addition of further practical tests.

The number of students in attendance at classes in technology, registered by the institute, has increased this year from 16,565 to 22,621. This large increase is mainly due to the introduction into the programme of an examination in "dressmaking," in which subject alone there were 58 classes, attended by 4,174 students. The number of candidates' papers in technology (not including manual training) which were presented this year for examination was 9,179, as compared with 8,534 in the previous year, showing an increase of 645. The number of registered classes for instruction in technology has increased from 610 to 689, and the number of centres of examination from 265 to 388.

These satisfactory results are largely due to the fact that the county councils have made grants to the technical classes, which have taken the place of the payments previously made by the institute. They are also due to the active co-operation between the institute and the educational committees of county councils, and they indicate the importance which local authorities assign to the institute's examinations and the value which artisans attach to the possession of the institute's certificate.

Whilst the number of passes has *increased* from 4,469 to 4,847, the percentage of failures has *fallen* from 47·6 to 46·4.

In Bombay one candidate was examined in electrical engineering, who obtained a certificate. From New South Wales 35 candidates presented themselves, of whom 18 passed. From New Zealand 6 candidates were examined, of whom 3 succeeded in satisfying the examiners.

Candidates in electric lighting can select one of three papers in the honours grade of the examination, whilst distinct examination papers are given to telegraphists and telephonists.

There are now 71 acting examiners on the staff of the

institute, beside 41 consultative examiners, who very readily assist the institute by their experience and advice. The difficulty of obtaining competent examiners who are themselves actively engaged in the trade, and who possess a thorough knowledge of the principles and theory of the subject, tends to increase rather than diminish with the progress of technical education. This is due to the fact that technical knowledge is advanced not only in the workshop and factory, but also in the schools, and it becomes necessary, therefore, in order to secure the proper combination of theory and practice in the question papers, to associate in many instances the practical manufacturer or craftsman with an experienced teacher, as co-examiners.

In electric lighting, notwithstanding the alleged increased difficulty in last year's papers, there is scarcely any diminution in the number of this year's candidates.

In telegraphy and telephony the number of candidates has increased from 209 to 240, and the percentage of failures from 48·3 to 50·0. In the ordinary grade the percentage of failures has risen from 53·9 to 65·7, and in the honours grade from 26·4 to 30·0. With reference to the large number of failures in the ordinary grade, the examiner reports that "the candidates have shown a lamentable ignorance of principles which are clearly explained in almost every standard text-book." In the section of telephony alone, which is a branch of the honours grade of the joint subject, the number of candidates has increased from 3 to 12, and the papers were of sufficient merit to justify the award of two prizes. In electric lighting 439 candidates were examined, and the percentage of failures has increased from 62·4 to 64·9. Copies of the examiner's report on this subject have been sent to the several centres where candidates were examined. In the quality of the answers in the honours grade a very decided improvement is reported to have taken place, but judging from the recurrence of the same mistake in large batches of papers, the examiners are of opinion that "in certain centres the teaching is in the hands of persons who have no real acquaintance with electrical engineering." In electro-metallurgy the papers in the ordinary grade are described as "very good, even those who failed showing the results of good teaching." The examiner states, however, that "the honours papers are less good, and that none of them show a clear knowledge of the principles of electrolysis."

In addition to the certificates of different kinds, the institute gives prizes in all technological subjects which are open to general competition among candidates from all parts of the country. The money prizes are given by the separate livery companies. This year 16 companies made contributions to the prize fund, in addition to the contributions given to the general funds of the institute. The number of prizes awarded is 218 as compared with 213 in 1892. The prizes consist of 85 silver and 133 bronze medals given by the institute, and of 194 money prizes, amounting to £382, given by the livery companies. The amount distributed as prizes last year was £352. The list of prize-winners has been separately published, but is appended to this report.

The number of towns in which the institute has centres has increased from 210 in 1892 to 264 in 1893, and the number of technical classes for each of the last four years has been 483, 519, 610, and 689, showing no break in the continuity of the increase. Of the centres outside London, Manchester has again sent up the largest number of successful candidates, the numbers being 313 as against 301. Next in order are: Bolton, with 246 passes as against 142; Dundee, with 126 as against 155; Leeds, with 123 as against 125; Glasgow, with 119 as against 213; Preston, with 115 as against 108; Birmingham, with 103 as against 91; Rochdale, with 95 as against 83; Leicester, with 86 as against 64; Oldham, with 85 as against 92; Edinburgh, with 82 as against 90; Bradford, with 81 as against 61; and Bristol, with 80 as against 63.

UTILISATION OF WASTE HEAT.

Now that the lighting of large and populous districts by means of central electric light stations has come so much into public favour, the question of reducing the cost of maintenance in connection with them has become a matter of special importance.

Much time and attention has been given to the production of economical engines, and at the present time many of our leading engineers are bringing their knowledge and experience further to bear on the subject, so that it is not unreasonable to expect that before long the cost of driving the prime motor will be reduced to the lowest possible figure. But we think the question of utilising the exhaust has not received that due consideration from engineers which it deserves. Of course every station has its feed water heater, but, as a rule, a low priced one is bought and is consequently only partially effective. To obtain a temperature of feed at 200° Fahr., is considered exceptionally good; but the importance of utilising the condensed steam water produced in the heater for feeding purposes, after extracting the grease used in lubricating the steam cylinders, is rarely considered.

The Chelsea Electricity Supply Company recently put down a heater installation, which not only returns about 30 per cent. of the steam water back to the boilers free from grease and all other impurities, but heats the whole of the feed required to a temperature of 208° Fahr., consequently a very large percentage of the temporary hardness is removed from the water and retained in the heater instead of passing into the boiler.

We illustrate a very interesting combination of water heaters manufactured by Wright's Patent Heater Condenser Company, of 16, Great George Street, Westminster, S.W., which has been extensively adopted, both in London and throughout the country in electrical lighting stations, hotels, and large buildings. In the latter cases the apparatus is of the

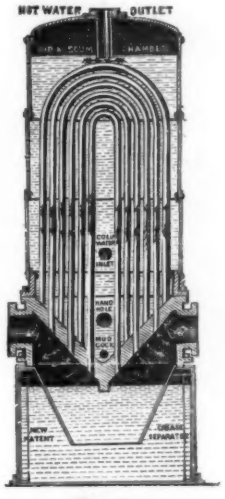

FIG. 1.

greatest value, because hot water is not only provided for feeding the boilers, but also for baths, lavatories, &c., and warming buildings by the utilisation of waste heat only. In addition to these advantages, the objectionable exhaust steam which is always a source of nuisance in hotels, &c., is entirely disposed of and the distilled water from it used for boiler feed.

Where electrical lighting stations are situated in close proximity to large buildings requiring a plentiful and constant supply of hot water, either for warming the building or domestic use, these heaters are most valuable, and have been employed with marked success. In one case where this plan has been adopted, the price paid to the company for heating an adjacent building with hot water goes a long way towards paying their coal bill; it is claimed that all this can be accomplished without the slightest possibility of creating back pressure on the engines.

Another important feature which presents itself is that in the operation of heating the water in the three heaters shown in the illustration, the greater part, or the whole, of the exhaust steam is condensed according to the amount of hot water required; and after the grease has been extracted the distilled water is returned to the boilers at a temperature of 208° Fah., thus securing a large saving in coals and water as well as repairs and renewals to the boiler plant.

The tank shown, upon which the heaters stand, is the grease separator, which receives all the condensed steam water that the three heaters produce; the necessary quantity of "make up" water is obtained from towns or other convenient source, and its supply to the separator regulated by means of a ball valve. The feed pump draws from this tank. the water in these three heaters passes out into the atmosphere at E. In case there should be at any time a short supply of exhaust steam, owing to an engine standing, an automatic valve is fixed at D, which admits live steam and closes again immediately the engine discharges its regular quantity of exhaust.

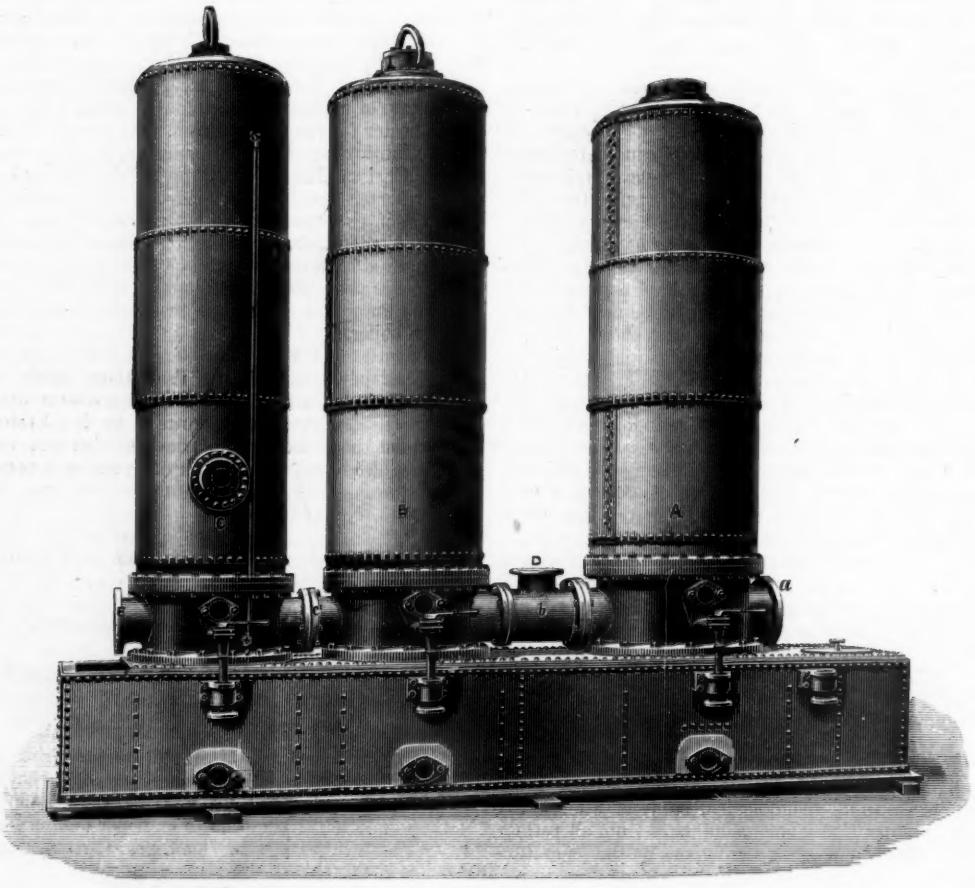

FIG. 2.

It will be seen from the section of one of these heaters, which we illustrate, that the steam passage through the heater is as direct as possible, and not the slighest back pressure can be created, as only ½-lb. pressure would break the water seal in the bottom and allow the steam to escape; but this does not prevent the steam passing up to the tube, because if sufficient pressure exists to force down the water it would be enough to force the steam up the tubes.

Plants similarly arranged to those shown in large illustration have been supplied by the above mentioned firm for the Savoy Hotel, Palace Theatre of Varieties, Knightsbridge Mansions, Whitehall Courts, Hotel Victoria, and many other large buildings. They have also supplied and erected a plant at the Chelsea Electric Light Station, Draycott Place, together with many others, but space does not permit of their enumeration.

Wright's Patent Heater Condenser Company have made the subject a speciality and have a wide experience in such matters.

The working of the heaters represented by the large illustration is very simple, and may be described as follows:—The exhaust steam from the engines enters the bath and domestic heater, A, at *a*, passing through the internal tubes on into circulating heater, B, through connection *b*, then, finally, into the feed water heater, C, by connection *c*. Any part of the steam which may not have been condensed in heating

RESEARCHES ON ELECTRICAL WAVE INTERFERENCE.

THERE is a long and exceedingly elegant paper in the *Archives des Sciences Physiques et Naturelles* [3] xxix., 1893, pp. 358—441, in which some recent researches on the interferences of electrical waves produced by normal reflection from a metallic plate are described.

According to the researches of Hertz, long electrical waves travel at a greater rate, apparently, through the air than they do along metallic wires; at the same time the velocities in the two media are approximately equal for short waves. This inequality has given rise to much theoretical argument, if not speculation. Accordingly MM. Sarasin and De la Rive, whose united investigations have so often enriched our knowledge, instituted experiments on a large scale in order to determine this question of the inequality in the rate of propagation of the waves.

A building connected with the Forces Motrices du Rhône at Geneva was selected as the scene of the investigation. Against a wall in the interior of this building was placed a metallic reflecting surface 8 m. in height and 16 m. in breadth, consisting of zinc 0·5 mm. in thickness. A camera-like box 10 m. long and 1·50 m. wide, made of black paper, rested against the surface of the metallic screen and pro-

jected into the room, forming a dark chamber, which was supported at such a height that a normal through its centre to the metallic surface was 4 m. above the floor. Finally, a species of "optical bank" ran through the centre of this chamber, on which the various resonators which were used were mounted.

For producing the electric sparks an apparatus was made use of which was essentially similar to that employed by Hertz in his well-known classical experiments, with the exception that the Rhumkorff coil was excited by means of a dynamo machine. The spark apparatus was placed at a height of 4 m. and 15 m. from the mirror, and by moving the resonator to and fro in the dark chamber, points of interference of the direct and the reflected waves were obtained.

One of the resonators needs special mention. It was 0·75 m. in diameter and consisted of a hollow tube of copper bent into a circle. The exterior diameter of the tube was 1 cm., and one end of the tube was provided with a micrometer for measuring the spark gap. It was found that a reflecting surface of at least 12 m. to 14 m. in length and 8 m. in height, was necessary to produce the phenomena with this resonator; and that with a resonator 0·05 m. in diameter, the necessary reflecting surface was 8 m. by 8 m.

The conclusions arrived at from this investigation may be briefly summarised as follows:—The circular resonator responds to a constant wave-length whatever may be the dimensions of the exciter; the intensity of the secondary spark alone varies, attaining its maximum for a given length of the exciter. One-fourth of the wave-length of a circular resonator is approximately equal to twice its diameter. In the case of normal reflection from a metallic surface, the first node is exactly at the mirror. The velocity of propagation of an electric wave *is the same* for air and for conducting wires.

OUR REPORT ON EPSTEIN ACCUMULATORS.

June 24th, 1893.

The Epstein Accumulator Co., Ltd.

EPSTEIN TRACTION ACCUMULATORS.

REPORT OF TESTS.

Gentlemen,—The Epstein accumulators are formed by direct oxidation without the use of paste; they are simple, easily managed, and apparently very reliable; the plates are very strong and few in number, the reduction of the component parts constituting a great advantage, especially when employed for traction work.

Two sets of tests have been made; with a 5-cell traction battery hermetically sealed to prevent the escape of solution, and on a 1-cell accumulator (open) supplied to show the construction of the cells in the 5-cell battery. The plates are of the Planté type of substantial construction, having their surfaces grooved, thereby increasing the active surfaces of the materials.

The following are the particulars of the open cell.

	Weight. lbs.
One positive plate, 19⅝ths inches by 8 by ⅜ths inch ...	14
Two negative plates, 19⅝ths inches by 8 by $\frac{3}{16}$ths inch	17½
Ebonite cases, 21⅝ths by 11 by 2 by ⅛th	3½
Solution	12
Wood box containing ebonite cell (this is not usually supplied, and the weight should therefore be deducted)	10
Ebonite insulators	½
Total	57½
One five-cell traction battery	244
Average weight per cell	48·8

These cells, which were represented as being capable of developing 90 ampère hours at a 30 ampère rate, we received ready charged on June 16th, 1892, and remained at rest until September 7th, before the first discharge, when they were joined in series and gave out 71·273 ampère hours and 801·494 watt hours. They then received one charge of 100 per cent. more current than their specified output, followed by a series of discharges at 30 ampère rate, and charges of 5 per cent. above their output at the same rate, until September 10th, when after a charge of 95 ampères and 1,291·4 watt hours, they were left at rest until November 18th (during which time no special care was taken to insulate them) when they gave out 55·65 ampère hours and 600·59 watt-hours, being 55·59 per cent. quantity and 45·51 per cent. energy efficiency of the charge they received on September 10th. This was followed by consecutive tests terminating on November 24th.

The following is the mean of the observations made during the two experiments:

Charge.		Discharge.		Efficiency.		
Ampère hours.	Watt hours.	Ampère hours.	Watt hours.	Ampère hours.	Watt hours.	Dates.
94·9	1,367·92	89·72	1,058·80	94·58	77·69	Sept. 7—10
94·8	1,351·63	91·42	1,058·99	96·44	78·44	Nov. 18—24
		Mean 90·57	176·50 per cell.			

It therefore follows that:

176·5 watt hours corresponds to 5·605 watt-hours per lb. of combined + and − plate.
" " " " 12·61 " " of + plate.
" " " " 3·618 " " of cell.

And therefore:

30 ampère rate corresponds to 0·9528 ampères per lb. of combined + and − plate.
" " " " 2·143 " " of + plate.
" " " " 13·51 " " sq. foot + plate.
" " " " 13·51 " " " − plate.

It will thus be seen from these results that so far as regards the behaviour of the accumulators when at rest, they act in every way as represented by Mr. Epstein, even to the remarkably good results obtained after long intervals of rest, and they confirm the very favourable report made on the Epstein accumulator, in July of last year, by Prof. W. E. Ayrton, F.R.S.

We remain, Gentlemen,
Faithfully yours,
(Signed) H. ALABASTER, GATEHOUSE & Co.

A DOUBLE FILAMENT INCANDESCENT LAMP.

THE EDISON-SWAN COMPANY are now making an incandescent lamp, which for some purposes should be extremely useful. It is known as the double filament incandescent lamp, and is manufactured under a patent of Mr. Gimingham's. The bulb with its two filaments is arranged in such a manner

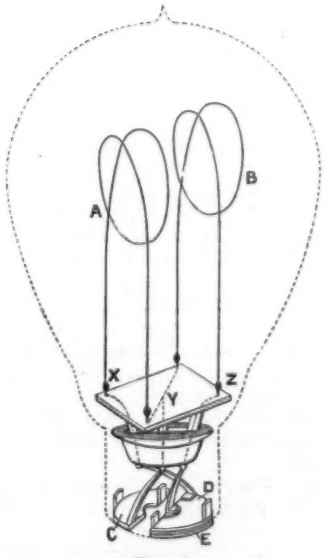

FIG. 1.

that when one is worn out the second can easily be placed in circuit. A reference to the figures 1 and 2 will make the matter clear. In fig. 1 the middle wire, Y, is attached to one of the usual contact plates, C, and the outer wire, X, is

attached to the contact plate, D. The other outer wire, Z, is attached to another contact plate, E, which is placed immediately under the plate, D, but insulated from it by a very thin layer or membrane of non-conducting material. On the lamp being put in circuit the current entering by the contact plate, E, and issuing by C, or conversely, causes only the one filament, B, to become incandescent, but when B is worn out, the plate, E, can be raised and the insulating material between the two plates, D and E, being withdrawn and scraped away, the plate, D, which had been previously insulated is now brought into circuit, and thus the other filament, A, is rendered incandescent. In like manner, when more than two filaments are placed in one bulb, their leading in wires are connected to separate contact plates, each insulated from the other, so that each in its turn can be put in circuit by removing or scraping away the insulating material from between it and the contact plate for the filament previously used. As shown in fig. 2 the middle wire, Y, is

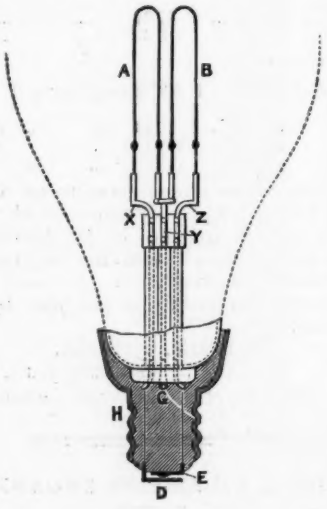

FIG. 2.

connected by a cross wire, G, to the socket, H, the wires, X and Z, being respectively connected to two contact plates, D and E, thin insulating material being placed between them as in the first instance, which is easily removed when one of the filaments is worn out, the other being immediately brought into circuit. This latter arrangement is specially applicable for lamps used in series, as instead of short circuiting and so cutting a lamp out when it is worn, the current of high potential simply penetrates the thin insulating membrane, and causes another of the filaments to become incandescent.

THE DEVELOPMENT AND TRANSMISSION OF POWER FROM CENTRAL STATIONS.*

BY PROF. W. CAWTHORNE UNWIN, F.R.S.

V.

TRANSMISSION BY COMPRESSED AIR.

COMPRESSED air transmission is a perfectly general method of distributing power for all purposes. The loss in the air mains is very small. The motors worked expansively are efficient. The mains can be carried by any path, and differences of elevation between the compressing and working points do not sensibly affect the result. In hydraulic transmission the water must be collected, stored, and in some cases filtered; and having actuated a motor, means must be found for removing it. But air is everywhere available, and can be discharged anywhere without causing trouble. Compressed air has peculiar advantages in the case of underground transmissions. It has been very unfortunate that in both the great installations in Paris and in Birmingham there were conditions of development very unfavourable to the complete and fair trial of compressed air as a means of transmission. It is reasonably certain that with greater attention to scientific principles better results are attainable than have hitherto been reached in the use of compressed air.

For the special purposes to which power distribution is applied in London, the high-pressure hydraulic system has great advantages. Where local conditions permit the construction of high-level reservoirs, a system like that in Zurich and Geneva of hydraulic distribution is perfectly successful; but, in more numerous cases, compressed air is likely to prove preferable to hydraulic transmission. It is also the most important rival of electrical distribution. So far as can be judged at present, in the case of distribution of power in towns, and especially where work has previously been done by steam engines which can be converted into air motors, in such cases compressed air is likely to prove a more convenient and cheaper means of power distribution than electricity.

General Considerations on Compressed Air as a means of Distributing Power in Towns.—The desiderata in a system of power distribution in towns may be shortly enumerated as follows:—

1. The possibility of indefinitely sub-dividing the power distributed and measuring the supply to each consumer.
2. Minimum first cost of distributing mains, and minimum loss of energy in distribution.
3. Simplicity, cheapness, and efficiency of the motors required by consumers of power; and, especially, it is important that the motors should require little attendance and involve little risk.
4. Freedom from danger to life or property when accidents occur to motors or distributing mains.
5. Facility of adaptation to various requirements additional to the supply of motive power. This is important, both from the additional revenue obtained, and because the more various the applications satisfied the better are the conditions of working at the central station. The fluctuations of demand are diminished and the load line improved.

A compressed air system meets these conditions on the whole more completely than any other system hitherto carried out. Experience in Paris shows how great the facility is for sub-dividing the power in a compressed air system. There are motors ranging from 150 horse-power to less than $\frac{1}{10}$th of a horse-power (45 foot lbs. per second). The majority of the air motors are in fact of less than 1 horse-power. These can be started and stopped by merely opening or closing the supply valve, and the measurement of the air used presents no practical difficulty. In Paris and in Birmingham the air is measured by meters, which are not costly, and which are accurate enough to give satisfaction. As to the distributing mains, it may be pointed out that in an air system no return main is required, the air being discharged at the working point without creating any nuisance. In a steam distribution a return main is desirable to avoid heat loss, and in an electric distribution a return main is necessary. Air mains are less costly than hydraulic mains or steam mains. Under what conditions they are less costly than electric mains is a question yet to be determined. Probably they are much less costly than electric mains, except in cases where high electric pressure can be used, and overhead conductors. M. Solignac has considered the case of the transmission of the 70,000 horse-power from Billancourt to the Place de la Concorde, at Paris, a distance of 4¼ miles. He comes to the conclusion that air mains would cost £112,000, while electric mains, worked at 2,000 volts, would cost £700,000. Even if the energy were required at the terminus in the form of electricity, he concludes that it would cost 20 per cent. less to transmit by compressed air, and generate electricity at the terminus by dynamos driven by air motors, than to generate and transmit the electricity from Billancourt. As to loss of energy in the mains, electricity has little advantage over compressed air. The pressure loss in the mains of a town distribution is insignificant. In the Paris system the principal mains have an extension of 55,000 metres (34 miles). The loss of pressure between St. Fargeau and the most distant point of the main rarely reaches 8 lbs. per square inch. The safety of an air main is obvious, and even a leakage or burst of the main is much less serious, and attended with less damage, than that of a water or a steam main. Air leakage is less dangerous than electric leakage. When an air distribution is introduced in a town, power users do not require new plant, and need incur no outlay for motors. The boilers—with all their attendant disadvantages of stoking, removal of ashes, cleaning, and risk of explosion—are dispensed with, and the steam engine, with little alteration, serves as an air motor. If an electric system is introduced, the old motors must be removed and new motors purchased. Further, if electric motors are themselves of high efficiency, they run at a high speed, and in most cases there is a considerable loss in the gearing required to adapt them to ordinary purposes. For small power users there are rotary motors of simple and cheap construction. Lastly, air motors are so simple that they require when working extremely little attention.

In regard to adaptability to various requirements, compressed air is in a very advantageous position. Electricity supplies power and light, but it cannot be used for supplying heat except at a cost prohibitive in most applications. Gas supplies heat, and power, and light, but, for lighting, it is open to obvious objections, and for heating and power it is expensive. Pressure-water supplies power, and, indirectly, light, if a motor is used to drive a dynamo; but, except where cheap water-power is the original source of energy, it is too expensive for most purposes where motive power is required. Steam supplies heat, motive power, and, indirectly, light, if a steam motor is used to drive a dynamo; but it is more expensive than compressed air, and involves more risk and attention.

Compressed air can be supplied so cheaply, that not only can it be used directly as a source of motive power, where that is the commodity required, but it can be advantageously used to drive sub-stations and private installations for generating electricity, for lighting purposes, or for working pumps and ventilating fans. With a water cushion between the air and the lift ram, compressed air is as convenient for working lifts as pressure water. It has been used in working cranes

* Abstract of Howard Lecture delivered before the Society of Arts.

at the Cockerill works for 20 years. Compressed air is not directly a source of heat, but used for blowing purposes it is an extremely useful adjunct to furnaces. In Birmingham, smiths' fires and cupolas have been worked direct from the air mains without any blowing machinery. A small jet of high pressure air induces a large stream at lower pressure. In Paris, compressed air has important applications for refrigerating purposes. Besides large refrigerating stores in some restaurants, an air motor is used for driving a dynamo for lighting purposes, and the cooled exhaust from the air motor is used to cool chambers in which food is stored. Lastly, compressed air is already used in working tramways, and it appears likely that much larger applications of this kind are possible.

General Arrangement of a System of Compressed Air Transmission.—The arrangements include:—1. A compressing plant driven by steam or water-power with air reservoirs of more or less capacity to diminish momentary fluctuations of pressure. The compressors usually require the addition of cooling arrangements for absorbing the heat developed in compression. 2. A system of air mains for distributing the compressed air to the working points. 3. Air motors driven by the compressed air and sometimes provided with re-heaters to increase the work done by the air and diminish the cooling during expansion.

The efficiency diminishes rapidly with increase of initial pressure; and it is the use of bad and inefficient air plants of this kind which has given compressed air a bad name, and made engineers hesitate to adopt high working pressures. To obtain good results, the air must be used expansively.

Practically, it is necessary to use pressures of 45 lbs. per square inch at least, that the apparatus may not be too cumbrous. When using the air properly, much higher working pressures may be adopted without sensible loss of efficiency.

Various means have been adopted to cool the air during compression. Sommeiller adopted water pistons, which are very effective, and, in the early compressors at Mont Cenis, very good results were obtained. But there are practical objections to water piston compressors; they must be worked slowly, and are costly and cumbrous. In the St. Gothard compressors, the much less effective arrangement of a cold water jacket was adopted; but air does not part with heat readily to a metal cylinder, and the cooling surface of the cylinder is too small to permit much of the heat to be abstracted, hence, later, a method proposed by Prof. Colladon of injecting a water spray into the cylinder was adopted, and by this means a much more considerable cooling action was obtained. To some extent, however, the cooling action of the spray is deceptive; the cooling takes place partly in the passages of discharge, and the compression curve is not lowered so much as it should be.

In most compressors simple fluid moved valves are employed. The objection to them is that they create some prejudicial resistance involving waste of work, and they prevent the compressor being worked at high speed. In many compressors mechanically moved valves are employed, for instance, slide or Corliss valves. The compressor can then be run faster, but the resistance at the valves is still serious. Prof. Riedler uses valves which open automatically and are closed mechanically, and these no doubt obviate the objections to ordinary valves.

Losses in Transmission.—The frictional resistances in a pipe conveying fluid are proportional to the density of the fluid; consequently, at equal velocities, the frictional resistance of air is enormously less than that of water. Conversely, air may be transmitted in air mains without serious fall of pressure, at 10 or 20 times the velocity practicable with water in water mains. Air, at 90 lbs. per square inch pressure, is about 115 times lighter than water, and the frictional resistance, at equal velocities, is less than 1 per cent. of that of water. In air mains there is nothing analogous to the hydraulic shock, due to changes of velocity, which, as well as the friction, leads to a limitation of the velocity of water in mains to 3 feet per second in most cases, or to 6 feet per second in some cases.

In air mains velocities of 30 to 50 feet per second are allowed, without serious frictional loss. In consequence of this high velocity, large amounts of power can be transmitted by air at moderate pressures, and in mains of moderate dimensions.

The hydraulic mains of the London Hydraulic Power Company are 6 inches in diameter, the pressure is 750 lbs. per square inch, and the velocity 3 feet per second. That corresponds to the transmission of 90 effective horse-power by each main. But air at 45 lbs. pressure per square inch, with a velocity of 50 feet per second, would transmit 150 effective horse-power in a main of the same size. The largest high pressure hydraulic mains are 7 inches in diameter. But there is hardly any limit to the size of air mains. The new Paris main from the Quai de la Gare to the Place de la Concorde—7 kilometres in length—with air at 90 lbs. pressure per square inch, transmits 6,000 horse-power.

In the older Paris mains which were carried through the sewers, and which had an exceptionally large number of bends, draining boxes and other sources of resistance, the frictional resistance, with a velocity of 25 to 30 feet per second, only amounted to 2 lbs. per square inch, per mile of main. It would be only in very long distance transmissions that the fall of pressure in the mains would be large enough to sensibly affect the efficiency of the system.

As to the precise way in which a fall of pressure in the mains influences the efficiency, there is a word to be said. If air enters an air main at 60 lbs. per square inch gauge pressure, and reaches the other end at 55 lbs. gauge pressure, there being a fall of pressure of 5 lbs. due to friction, then it is commonly stated that $\frac{5}{60}$ths of the energy of the air is wasted. But this is altogether erroneous, the statement being based on a false hydraulic analogy. With the fall of pressure in the case of air, there is an expansion of volume which largely compensates for the loss of pressure. The intrinsic energy of the air from which the work of the air motor is borrowed remains constant. It is only because the air motor works against the pressure of the atmosphere that the available energy of air at 55 lbs. is less than that of air at 60 lbs. pressure.

Suppose that a given amount of work can be done by an air motor using a ton of air at 60 lbs. gauge pressure, or 75 lbs. absolute. The work expended in driving this motor by a compressor adjacent to it would be the work of compressing 1 ton of air to 75 lbs. absolute pressure. Now let the compressor be removed to a couple of miles distance, and the air supplied to the motor through a main, in which there is a fall of pressure of 5 lbs. per square inch. To do the same work as before, all that is necessary is that a ton of air should be compressed to 80 lbs. absolute pressure. The difference between the work of compressing a ton of air to 80 and to 75 lbs. absolute pressure is the loss of work arising out of the friction of the main, and this amounts, with fairly good compressors, to about 3 per cent.

In short distance transmissions the loss of pressure in the mains is so insignificant that it may be neglected. In long distance transmissions an accurate estimate of the frictional loss is necessary. The author believes that he has shown, using data derived from careful experiments on 20 miles of main in Paris, that long distance transmission of power by compressed air is perfectly practicable. It is possible, with compressors driven by engines working to 10,000 indicated horse-power, to transmit the air, in a main of not unusual size, a distance of 20 miles, and to obtain in motors worked by the transmitted compressed air from 4,000 to 5,000 indicated horse-power, if the air is used cold, or 6,000 to 7,000 indicated horse-power if the air is re-heated before use.

The Air Motors.—The air motor is essentially a reversed compressor, but it is free from the heating difficulty. The air cools in expanding, and in some cases this causes trouble from the production of ice in the valve passages. The rounding of the edges of the ports so that the ice can be pushed away diminishes the trouble, and heating the air before use entirely obviates it.

Some special rotary motors of small size are used in Paris; but they are not economical, and most of the motors are simply non-condensing steam engines adapted to use air. Probably the greatest cause of loss in air motors has been leakage, especially piston leakage. In a steam engine, the condensation on the cylinder wall helps to make the piston tight. In an air motor the cylinder surface is dry, except so far as lubricant is supplied.

Cost of Working with Compressed Air.—Air motors can be obtained, erected complete, for two-thirds of the cost of a steam engine and boiler. In the very imperfect small rotary motors in Paris, the consumption of air compressed to five atmospheres (75 lbs. per square inch) is 750 to 850 cubic feet per effective horse-power hour. Old steam engines converted to air motors use 450 cubic feet per effective horse-power hour. Now, the new compound air compressors at Paris compress a cubic metre of air to a higher pressure than this for 0·4 centime. If 0·75 centime per cubic metre is allowed to cover interest on plant, as well as cost of compression, this corresponds to 1d. per 880 cubic feet of compressed air. Hence, the cost of working with compressed air amounts to 1d. per effective horse-power hour with the inefficient rotary motors, and about ½d. per effective horse-power hour with the converted steam engines. In the latter case the cost corresponds to about £6 5s. per effective horse-power for a year of 3,000 working hours. Better results than these will be obtained when air motors are studied as carefully as air compressors.

Heating Air before Use in Motors.—The amount of expansion which can be permitted in air motors, without inconvenience from the fall of temperature, is limited. Any difficulty thus arising is obviated if the air is heated immediately before it is used.

Quite apart, however, from the removal of a practical difficulty, the reheating of the air before use is of the greatest economical importance. The air, when heated, expands, and more work is obtained in the motor per pound of air used. Whether it is economical or the reverse to heat, the air before use depends on this—whether the additional work obtained is more or less valuable than the coal expended. Experience shows that it is extremely advantageous, economically, to reheat the air. The heat supplied is used with great efficiency, and a larger fraction of it is converted into work than in ordinary heat engines. Further, very small, easily managed, and simple re-heating apparatus can be employed. A simple coil of pipes, with a small furnace capable of heating the air current to 300° F., may increase the work done per pound of air by 25 or 30 per cent. The heat, according to the experiments of Riedler and Gutermuth, is used five or six times as efficiently as heat supplied to a good steam engine.

Combination of a Gas Motor and Air Engine.—In a scheme for distributing power, chiefly by compressed air, for the town of Dresden, Dr. Prœll proposed to work an electric lighting station partly by air motors, and partly by gas engines. The ordinary re-heating apparatus for air motors is not very convenient in this case, in consequence of the great variation in the demand for power. Hence Dr. Prœll adopted the plan of combining gas engines with air motors. The gas engine is, itself, a very efficient and convenient motor for an electric lighting station, because it can be put in action or stopped, according to the variation in the demand for power, and there is no waste like that due to keeping boilers in steam ready for use. But in gas engines a very large fraction of the heat developed is necessarily wasted in the water jacket. Dr. Prœll proposed to abolish the water jacket, and to take the compressed air through the gas engine jackets, to re-heat it on its way to the air motors. In addition, the hot gases rejected from the gas engine were to be used in the jacket of the air motors. Undoubtedly by the combination of the gas engine and the air motor a quite remarkable thermal efficiency could be obtained.

It may be questioned whether it would not be better to take the exhaust of the gas engine directly into the air current. Then the gas engine would work with a heavy back pressure, but the work so lost would be recovered in the air motor. The author has suggested re-heating by the burning of gas in the air current, so that the whole of the heat would be utilised without chimney losses. Some attempts have since been made in this direction in America.

DISTRIBUTION OF POWER BY STEAM.

The defects of steam as a means of distributing power may be balanced by its convenience as a means of distributing heat. At any rate, in America the experiment of distributing heat and power from a central station by steam has been tried on a very large scale, and with a considerable amount of success.

There are now two steam stations in New York, a down-town station termed Station B in Greenwich Street, which has boilers working to about 16,000 horse-power, and an up-town station in Fifty-eighth Street, designed for boilers of 3,000 horse-power, and having about half this power at work.

The pipes from the down-town station extend through about 5½ miles of streets; those from the up-town station through 2½ miles of streets. They work with steam at 80 lbs. to 90 lbs. pressure per square inch. The main pipes are of wrought iron, 16, 15, 13, and 11 inches in diameter outside, and about ½-inch less in diameter inside. Return mains were also laid for the condensed water. These were 6 inches and 8 inches in diameter near the stations, decreasing to 4 inches, and even to 2½ inches, towards the ends of the pipe lines. More recently the return mains have been disused on account of their rapid corrosion.

The steam is used for a great variety of purposes, in addition to the principal purpose of warming buildings. It is used for driving engines for various manufacturing purposes; for driving engines for electric lighting; for engines working lifts, and for engines for ventilation. In 1887, there were some 500 engines worked with steam from Station B.

Prevention of Loss by Heat Radiation.—To prevent loss by radiation, the pipe is surrounded by non-conducting material. For this purpose, in different cases very different materials have been used. Straw, laid parallel to the pipes, and covered with loam, is effective; but there have been used felt, cork, fossil meal, *papier maché*, slag wool, and asbestos. Slag wool, obtained by blowing super-heated steam through molten slag, is exceedingly efficacious, from the large amount of air it retains in the interstices of the wool; but if it gets moist, the sulphur it contains causes rapid corrosion of the iron pipes. Probably, with any of the coverings mentioned, moisture would also be very injurious.* It is, therefore, important to keep the outside of covered pipes dry, and this is best secured when the pipes are kept continuously heated.

In the case of the New York steam supply, the pipes are laid in brick trenches, the brickwork being kept 4 inches away from the pipes. The pipes were coated with hot asphalt varnish, and the space packed with slag wool. Over the pipes a roof of short planks, smeared with tar, and bedded in cement, is used, and a covering of tarred paper over the planks was carried well down the side walls to exclude percolating moisture.

The general arrangement of the pipes is to have an expansion joint every 50 feet, and two intermediate joints, all the joints being carried on brick piers with a stone cap. At all dips in the pipe traps are connected for discharging the condensed steam.

With steam, very large amounts of power can be transmitted, without sensible pressure loss, through mains of moderate size.

* *Proc.* Am. Soc. C. E., xii., p. 263.

LEGAL.

WILKINSON *v.* MEDICAL BATTERY COMPANY, LIMITED.

A RECEIVER APPOINTED.

IN the Chancery Division of the High Court of Justice, on Friday, the 27th ult., Mr. Swinfen Eady, Q.C., appeared before Mr. Justice North in support of an application on behalf of the plaintiff, who was a debenture holder sueing on behalf of himself and all other debenture holders of the company to the amount of upwards of £7,000, that a receiver might be appointed of the property comprised in and charged by the debentures.

The Learned Counsel said that there were circumstances connected with the defendant company which made it inexpedient that any application should now be made for the appointment of a manager, or that the court should be asked to give directions with regard to the carrying on of the business. According to the terms of the debentures the principal money had become payable. The debentures contained a clause to the effect that the principal money should become payable (amongst other things) if the company should issue a notice convening any general meeting of the company or its members for the purpose of considering or resolving upon the discontinuance of the undertaking, or the winding up of the company. The company had issued a notice and they had convened a meeting for voluntary winding up—that was proved. It was a case to which some public attention had recently been drawn owing to a series of articles which had appeared in the newspapers. The present position of affairs was that Mr. Harness, the managing director, had resigned his appointment, and that creditors were suing the company.

Mr. JUSTICE NORTH: Do the defendant company appear?

Mr. HENDERSON: I appear for the company, and I consent to the application.

Mr. JUSTICE NORTH: Then I do not know that the facts need further be gone into; the plaintiff's debentures are proved to be due; the plaintiff asks for a receiver and the company do not object.

Mr. SWINFEN EADY: It is important that possession should be taken at once.

Mr. JUSTICE NORTH: Do the company consent to the appointment of the person the plaintiffs name?

Mr. HENDERSON: Yes.

Mr. SWINFEN EADY asked that the receiver might be at liberty to act at once, and that until he had given security in the ordinary course the plaintiff should be answerable for his receipts.

Mr. JUSTICE NORTH said the receiver must forthwith complete his security, and the plaintiff be responsible for the receipts in the meantime.

WAGSTAFF *v.* THE EDISON BELL PHONOGRAPH CORPORATION.

IN the Chancery Division of the High Court on Friday, before Mr Justice Stirling, a motion in the action Wagstaff *v.* the Edison Bell Phonograph Corporation, Limited, came on for hearing. Mr. Hastings, Q.C., appeared for the plaintiff, and Mr. Millar, Q.C., for the defendant Corporation.

Mr. HASTINGS said that the motion was on behalf of the plaintiff, and it asked for an order restraining the defendants, their servants and agents, from carrying on an exhibition of their phonograph machines at 56, Gracechurch Street, or otherwise using the premises in such a manner as to cause crowds to assemble and obstruct the access to the plaintiff's premises.

Mr. MILLAR, interposing, said that the question was whether a number of persons resorting to a house constituted a nuisance, and, particularly, one that the Court would deal with by interlocutory injunction. He submitted that the matter was one which could not be dealt with without cross-examination.

Mr. HASTINGS said that might be so, but this was ruining his client's business, and he proposed to ask the Court for an interim order.

After some further discussion between Counsel, his LORDSHIP said that the evidence which had been read had produced a certain impression on his mind. But there was a direct conflict of evidence, which made Mr. Millar within his right in the application to cross-examine. He would not, however, send it to the Examiner for that purpose. Instead, he would give the parties an early day to try the case out in Court.

It was then arranged to take the hearing of the case on Wednesday, November 15th, subject to any part-heard case undisposed of upon that day.

ST. JAMES'S AND PALL MALL ELECTRIC LIGHT COMPANY.

ON Wednesday Mr. Justice Kekewich, sitting in the Chancery Division, heard an action brought by Mr. Charles Robert Fry and Colonel George Edward Francis, suing on their own behalf and on account of all other owners of founder's shares in the St. James's and Pall Mall Electric Light Company, Limited, against that company, the object of the action being to obtain a decision whether the company, under its articles of association, could carry over from the net profits a yearly sum of £1,000 to a redemption fund, to the detriment of the holders of founder's shares.

Mr. Renshaw, Q.C., and Mr. Whinnie were counsel for the plaintiffs; and Mr. Warmington, Q.C., with him Mr. Swinfen Eady, Q.C., for the company.

The company was formed in March, 1888, with a capital of £100,000 in £5 shares, less 100 founder's shares of £1 each, increased in 1891 to £200,000 by the issue of 20,000 £5 seven per cent. preference shares; the whole of this capital was taken up. In 1890 a dividend was paid at the rate of 5 per cent., a figure not sufficient under the memorandum of association to enable founder's to share in the profits. At the end of 1891, however, 8½ per cent. was paid on the ordinary shares, and each founder's share received £10 15s., representing half of the surplus profits for the year; whilst in 1892, after paying the preference shares, 7½ per cent. was paid to the ordinary shareholders, and three guineas to each founder's share. Plaintiffs complained that, to the detriment of the founder's shares and in favour of the ordinary and preference shareholders, the directors had taken from the revenue account £1,000, both in 1891 and 1892, and applied it to a redemption fund instead of distributing it, as they submitted ought to have been done, amongst the shareholders. His Lordship was asked to decide whether in so doing they had acted within their powers.

For the defendant company, Mr. WARMINGTON, Q.C. (with him Mr. Swinfen Eady, Q.C.), submitted that unless the directors' *bona fides* were challenged—and there was no imputation of *mala fides* against them, they having acted under most experienced advice—the plaintiffs had no *locus standi*, and they had acted in consonance with their memorandum of association.

His LORDSHIP remarking that the point was a new one, founder's shares being such a modern invention as not yet to have obtained a technical meaning, said if it were a question of internal management the Court would not interfere. It was, however, a question of contract, and as he read the memorandum of association, the holders of founder's shares were entitled to a share in net profits which, without imputing *mala fides* to the directors, had not been distributed. He therefore decided in favour of the plaintiffs, and ordered the company to pay the costs.

CORRESPONDENCE.

Arc Lighting.

In his letter of October 6th, Mr. Carter skillfully shifts the point of criticism so as to put me in the position of defending the closed coil high pressure dynamo for arc lighting in opposition to the open coil type. I am unwilling to be placed in this position; and if your readers will examine my note in your issue for September 29th they will fail to find a single word about open coil dynamos. My point of criticism relates to Mr. Carter's statement in your issue for August 25th, which runs as follows: "Beyond about 1,000 volts it is found, in general, to be impracticable to work a closed coil armature; for either there will be wastefully large lead, or there will be vicious sparking under the brushes, or the current will flash from strip to strip and will destroy the commutator." What I want to assert in as plain terms as possible is, that these statements of Mr. Carter are wholly wrong. They are either the result of observation and examination of badly designed machines, or have been taken, without the necessary grains for allowance, from the statement of persons interested in convincing the public that none but open coil armatures are practicable for series arc lighting. It will be observed that I made no comparison between the two types of machines, nor am I interested personally in either mode of winding high pressure armatures. I am perfectly well aware that the greater part of arc lighting hitherto done in America has been done by Brush and Thomson-Houston machines; I am also aware that the largest central stations in this country are now using closed coil armatures. I refer to the St. Louis plant of Wood dynamos and the Cincinnati plant of standard machines.

I would also like to call attention to the fact that a large number of 50-light machines of both these companies are in use in Machinery Hall at the World's Fair; and at the last account not a single armature had been lost of the standard machines, and I have heard of none in the case of the Wood. None of the bad results pointed out by Mr. Carter are seen in these machines. Mr. Wood exhibits another dynamo in the Electricity Building for 125 arc lights, requiring, therefore, over 6,000 volts.

Since Mr. Carter insists on bringing into his reply Brush machines, I may add, as bearing on the position taken, that I am not advocating one type of dynamo as against the other; that the Brush Company has recently brought out a four-pole machine with open coil armature, capable of lighting 125 arc lights at about 500 revolutions per minute; and the company has received an award on it at Chicago, which I myself had the pleasure of writing. Mr. Carter is entirely in error as to the unanimity of opinion among experts in America, or "chief experts and authorities" as he puts it, in favour of the open coil dynamo for series arc lighting. If that were so it would indeed be curious that the Fort Wayne Company can sell practically all the Wood dynamos that they are able to manufacture; and that one of the great open coil companies, as I am credibly informed, is now designing a dynamo for series arc lighting with a closed coil Gramme ring.

Henry S. Carhart.

Ann Arbor, Michigan, *October 17th*, 1893.

Incandescent Lamps.

As one of your numerous readers, and, at the same time, being employed on the continent in the manufacture of incandescence lamps, I should like to say a word or two in connection with remarks in your leading article of October 6th issue, and further in regard to correspondence *re* "Incandescent Lamps," October 20th, concerning prices and quality of lamps made on the continent.

You would seem to hint in your leader that a lamp sold at a much lower price than at present advertised in England, must mean a bad or indifferently good one; whereas, the present competition on the continent has caused not only cheap prices, but has also been a means of ensuring better quality.

In England the Edi-Swan Company, having the sole patent rights, could issue their lamps without fear of comparisons being drawn by the consumers; whereas, on the continent, consumers have the advantage of judging between different makes. Therefore, in order to successfully compete one has been compelled to produce cheap and, at the same time, lamps of such good quality as to compare favourably with those of other makers, so that the competition is not alone in price, but also in quality, and, in order to accomplish this, one has been forced to be up to date in the most recent methods of manufacture, and to exercise the most economical and skilful management.

After the expiration of the patent rights in England your English lamps will no doubt be not only lower in price, but also of better quality than before.

The prices quoted by the Swan United in Germany ("sister" to the Edison and Swan), bear fair comparison with those of other continental manufacturers, and still her "sister" in England acknowledges that they are the most to be feared in the market, thus bearing witness themselves that moderately cheap lamps do not necessarily mean bad ones.

H. Hoge,
Chief Engineer H.I.L. Co.

October 27th, 1893.

Pumping by Electricity.

A correspondent writes as follows:—"Your correspondent, J. G., can do the pumping he requires admirably by electricity. Assuming that he runs his pumps for six hours per day, he will require an electric motor of about 5 H.P.

"It is not easy, without particulars of the available steam power, nature of delivery pipes, &c., to give any accurate figures, either of H.P. required, prime cost of plant, or running cost; but if your correspondent would put himself in communication with the Brush Company, of Loughborough, Electric Construction Company, of Wolverhampton, or. J. C. Howell, Limited, of Llanelly, who can all point to numbers of similar plant erected by themselves, he will, doubtless, be able to obtain all the information he requires, and estimates for the work."

What is Lithanode?

I have to thank Sir David Salomons for his note last week. I think, however, that he has not been altogether successful in elucidating his view. Let me state the question as briefly as possible.

1. Your note on page 396 gives my original definitions of lithanode as follows: (*a*) A highly-conductive form of peroxide of lead obtained by electrolysis from plates, layers, or masses, mainly composed of oxide of lead in a dense and coherent form, which it is the object of the patented process in the first place to obtain; and (*b*) peroxide of lead in dense yet porous self-supporting masses for use in voltaic batteries and for other purposes.

2. My letter on page 421 points out that Sir David in his book, speaks of "solid peroxide without a leaden support," of which, "in its present form, Mr. FitzGerald may be regarded as the inventor." Also that Sir David states that: "He (Mr. FitzGerald) gives the material the name of lithanode, but there is not the slightest reason for calling this well-known substance by a new name."

3. Sir David, in his note on page 447, observes that his statement has not hitherto been questioned, intimates that, for want of evidence to the contrary, he regards the lithanode plate as Mr. FitzGerald's production, suggests that there are in it other chemical substances in combination with the *lead salt*, states that a great many (persons) have taken objection to the word *lithanode*, and, finally, gives the following as a fair interpretation of his words:—

"That, although the solid peroxide plate was known, Mr. FitzGerald is probably the first gentleman who has made such a *plate* in a practical form by his process, but that it would have been better to have called the plate 'FitzGerald's peroxide plate,' or 'positive plate.'"

Possibly Sir David's few words of explanation may be intelligible to others; but, for my own part, I must confess that they have left me more puzzled than ever.

Taking the points in (3) *seriatim*: It by no means follows necessarily that, because a statement has appeared

in several editions of Sir David's book, it is therefore beyond question.

I cannot understand how, if the material I call lithanode be a well-known substance under a new name, Sir David can regard it, even in its present form and in the absence of (additional) evidence to the contrary, as my invention, or, as he now words it, my production.

I cannot understand what is the "lead salt" to which Sir David refers. A percentage of sulphate of lead (which is a salt), is present in lithanode in combination with the peroxide; but this is not a salt. *En passant*, I may observe that, strictly speaking, peroxide of lead, in powder as well as in the form of plates, is a *solid*, unless it be in solution. But by myself, as well as by others, the word has been used in a popular sense to signify: in the form of coherent and not readily disintegrable masses.

Who are the great many persons who have taken objection to the word lithanode? Curiously enough, I have not, to my knowledge, come across one of them.

To whom was the solid peroxide plate known prior to the date of my first lithanode patent? Are there any specimens of it extant? Would Sir David term a readily-disintegrable plate, such as one of ordinary peroxide strongly compressed, solid peroxide? What was the old name of the well-known substance which I named lithanode?

If there be not the slightest reason for calling the well-known substance by a new name, why should it be called "FitzGerald's peroxide plate" rather than lithanode? And why should I emphasise the fact of my Irish descent by calling the most electro-negative substance known "FitzGerald's *positive* plate? Is Sir David aware that the council of the Society of Arts, and other authorities, have deprecated and discouraged the association of personal cognomens with new or quasi-new products?

So far as is known, coherent, self-supporting, non-disintegrable masses, mainly composed of peroxide of lead, or what I have termed lithanode, can be produced only by the operation of comparatively slow, long-continued chemical action, allowing the particles of a lead compound to be converted into peroxide to re-arrange themselves in definite form, or "to set" by the effect of chemical and molecular attractions brought into play. This is really the essential point of my inventions in this direction, and the product is *the* more perfect the more completely this "setting" process is allowed to take place.

Desmond G. FitzGerald.

Electrical Education.

I am pleased to find that my article, published in your issue of 20th inst., has met with the approval of certain of your readers.

As Mr. Bowker points out (in last week's issue), "there is not the difference of standard between the Ordinary and Honours Grade Examinations that there should be." Very conclusive proof of this is afforded by the fact that at last May's Examination, one of my students who had originally intended to sit for the Ordinary Grade, on looking at the paper, thought that the Honours Grade questions seemed less formidable, so he worked them—*and passed*.

The state of things is really very serious, for, in setting such difficult papers the City and Guilds of London Institute defeats the main object of its existence by damping the ardour of practical workers, whose endeavour to acquire technological knowledge ought to meet with every encouragement.

It is natural that the Honours Grade paper should be of a high order of difficulty, and if the examiners think it necessary to maintain the present high standard of the Ordinary Grade, it is really essential that certificates should be granted upon the results of the preliminary examination.

As this is a matter which concerns all who are interested in this branch of electrical education, whether teachers or otherwise, it would be interesting to have the opinions of others of your readers upon the above, as well as upon my suggestion (*vide* issue, October 20th), that there is a necessity for the establishment of a new subject of instruction and examination under the City and Guilds of London Institute.

W. Perren Maycock.

October 28th.

Lightning Express Railway Service.

Before considering the practicability of organising such a service, and, if practicable, how to do so in an effective and economical manner, it was necessary to consider, if there were any indications of a desire on the part of the public for such a service, and further, if such a desire exists, would the fulfilment of it produce any beneficial results for the public welfare? The general desire to travel at a higher speed appears to have clearly manifested itself for a number of years in the efforts made by the existing railway companies to increase the speed of travelling to the utmost of their power. During the 60 years since railways were introduced, the original 14 miles per hour of Stephenson's famous "Rocket" has gradually grown into the maximum effective speed of 50 miles per hour of the fastest express trains of to-day, and still the craving of the public for increased speed seems far from being satisfied. This is shown in the numerous efforts made by many great railway companies in Europe and America to construct locomotives capable of travelling at an effective speed of 100 miles per hour, and by the many projects considered by different governments and companies for the establishment of rapid transit railways at speeds varying from 100 to 150 miles per hour. A few examples will suffice.

The Belgian Government has had under its consideration for at least two years such a project between Brussels and Antwerp. In Austria a similar project has been under examination during the same period for a line between Vienna and Pesth. In the United States of America a line from St. Louis to Chicago has been advocated, and, it is stated, is actually going to be begun. Experiments with a small trial line were made also in America, on which a speed of 184 kilometres per hour was obtained. The Great Northern of France, the Paris, Lyons and Mediterranean Railway Company, and many others, have spent large sums of money in trying to construct locomotives for the same purpose. All these efforts by the most experienced caterers for this particular branch of the public wants seem clearly to indicate a desire on the part of the public to obtain more rapid means of locomotion. And no doubt this desire is easily explained and justified by the actual condition of life in highly civilised countries. In the present day, when the bulk of the population of such countries tends to concentrate in large cities, and the country becomes more and more neglected, and the conditions of life in great cities become from day to day more difficult through overcrowding and excessive competition, undoubtedly it would have a beneficial result on the life and habits of the population in these highly civilised countries, if this desire of the public could be met in an effective and economical manner. It would be a means of again decentralising a great proportion of the population, and giving them the benefit of a healthy country life, combined with the possibility of attending to their business in the great centres of human activity represented by the great towns.

Having arrived at these conclusions, I was naturally led to examine the different projects before the public, as they did not seem to make that practical progress which was to be expected if they really afforded a safe and economical solution of the problem before us. I was struck by the many objections of the most serious character which could be advanced against all of them, both on the score of safety and economy, and therefore I have endeavoured to find a way to remedy these defects to the best of my power. The results of these investigations were, in their general outline, embodied in my pamphlet on "Lightning Express Railway Service," just published. It was impossible within the limits of such a treatise to explain all the minute details necessarily required in the practical construction of such a line. Still I have endeavoured to indicate, in a general way, that all points had been carefully considered, and had received, as far as I was able to judge, a satisfactory solution, which, however, can only be finally and conclusively tested by the construction of the first line on which these principles and details shall have been carried out and subjected to the test of practical working.

The objections I found in all existing projects can be stated under very few heads, viz.:—

1. The great difficulty in constructing the ordinary two-rail railway with curves of such a radius as would not entail an excessive cost of construction, on account of the enormous

power of the centrifugal force developed at such high speeds, and in such a manner as to render derailment impossible.

2. The danger of derailment from accidental irregularities or deformations of the permanent way, or from the breaking of a tyre, an axle box, a wheel, or an axle.

3. The danger of derailment from the mistakes of human agency in the working of signals, switches, crossings, the coupling of carriages, and other similar arrangements as at present in use on the ordinary railways.

Nearly all derailments may be ascribed, in a direct or indirect manner, to one of the above-mentioned causes, and none of these dangers seem to me to be provided against in the proposals before the public, prior to my project, in any greater degree than on the present railways at a lower speed. On the contrary, every one of these sources of danger seemed to me to be much intensified, and considering the grave consequences of derailments at the present speeds, unless means be devised to render derailments from any of the above-mentioned causes practically impossible, it will be neither safe nor politic in the interests of the public to authorise railways to be worked at a higher speed than at present, as the results of accidents at such higher speeds would be too horrible to contemplate.

To avoid the dangers created by an enormous development of the centrifugal force on ordinary railways, there seems no effective way of doing it except by avoiding curves of a radius of less than 15,000 to 16,000 feet, which practically means a straight line. But this would render those lines so expensive that they could not be constructed with any reasonable hope of a fair remuneration for the capital employed. "Lightning Express" railways will only be required in thickly-populated countries, where naturally many obstacles of a most serious nature will be met, if the lines have to be laid out without curves. Therefore, except in a few special cases, that reason alone would prohibit the practical working out of the proposed lines. The other causes of accident I mentioned would be equally difficult to avoid, and, besides those, there are also many dangers of accident which may arise from the breaking of vital parts of a steam locomotive, especially if such locomotives were to travel at much greater speeds. I was, therefore, led to recommend a totally different system of railways, to be worked by electricity. What I have endeavoured to show in my pamphlet is that by the adoption of the single-rail railways, worked by electricity, all these defects would absolutely disappear, or would not occasion derailments. Taking the objections to the former proposals in the order above enumerated :—

1. On the lines I propose curves of the ordinary radii, such as are employed on the great trunk lines, could be used without the possibility of derailment, as the line itself being encased in the carriage, no derailment could take place unless the line was broken in two, which could absolutely be avoided by making the line sufficiently strong to withstand the strains, which can be ascertained by simple formulæ known to all engineers. In this manner not only safety will be obtained, but also economy, as the new lines can everywhere follow the course of the existing great trunk lines.

2. The derailments produced by the irregularities of the permanent way, or by the breaking of the wheels, &c., are absolutely avoided in the construction of a railway as proposed. Our trains or carriages are to have, generally, a length of 100 feet, being propelled by 12 driving wheels all in the same line, one behind the other. Each of these wheels is to be furnished with two dynamos or motors, which are attached to the wheel itself. The result of this arrangement is that even should a break occur in one of the lengths of the permanent way, as each of these lengths is only travelled over by one wheel at a time, and as the whole length of the carriage must always cover twelve of these lengths (bays) or sections, if there were ever so great an irregularity or even a complete breakage at one point, the carriage would still have eleven wheels on the line, which would be amply sufficient to do the work required. It would only subject the steel and iron, of which the line and rolling stock is constructed, temporarily to slightly increased strains. But as the ordinary working strains on these parts is calculated at about one-seventh of the breaking strain, there could be no danger of any accident happening by such a temporary want of support in one bay out of twelve. The same reasoning applies in the case of the breaking of a tyre wheel, axle-box, or axle.

3. On the line as proposed by me there will be no possibilities of mistakes from human agency as far as switches, signals, crossings, and coupling of carriages are concerned, as they are all dispensed with. My railways consist of two parallel single rail lines between the two terminal stations, joined at these stations at either end by a curve, forming thereby a continuous closed circuit, on which each train follows the other at such short intervals as the service may require. These trains consist of a single carriage only, which does away with any risk of careless coupling. Each carriage can be made of any length desired to suit the requirements of the particular traffic under consideration, and the carriages are formed by links which move on joints inside the carriage in such a way that each link contains accommodation for 40 passengers, and therefore for 100 passengers and their luggage three links are required, for 60 passengers the carriage would consist of two links, and so on. These carriages are constructed to turn in curves of 150 feet radius in the stations whatever may be their length, and the running of one carriage into the one which precedes it is avoided by a system of electrical block divisions on all sections of the line, so arranged that when one carriage on any section meets with an accident which causes it to stop, the effect is instantly communicated to every carriage on the circuit, and as they are always at a distance of several miles of each other, they will stop long before they reach the spot of the accident. This arrangement has also other advantages independent of avoiding any accident from human agency; it is that it gives to the public a continuous service of trains, so that everybody can always be sure to find a carriage ready to start whenever he goes to the station, without waiting either for the departure or arrival of a train, and thereby avoiding an infinite waste of time.

As to the dangers inherent to traction by steam locomotives, these will be avoided by the substitution of electricity as the motive power, and this arrangement will further result in considerable economy in the construction of the line itself and the rolling stock, as it will considerably reduce the weight to be propelled, and therefore also the weight of the line itself.

Having now explained as succinctly as I could the aim of my work, and the general lines on which I have endeavoured to arrive at the desired results, I will discuss shortly a few of the details which I propose to apply, so as to answer some of the observations which have been made in one or two of the technical papers.

As to the electrical arrangements :—The power produced by the total number of motors on one carriage for 100 passengers is 1,600 H.P., or about double the amount required. The essential new feature of these motors is that they are attached to the driving wheels themselves, so that the wheels form part of the motor. In designing the different parts of the whole system, the great object kept in view has been to combine lightness with efficiency, as in a lightning express service it is essential to economise as far as safety will allow every pound of the weight. This reason finally decided me to adopt the proposed arrangement of motors placed in the carriages themselves, instead of using independent electrical locomotives. As at present arranged, my carriage for 100 passengers, including all the electrical machinery, viz., 24 motors on 12 wheels, capable of producing 1,600 H.P., weighs when loaded 60 tons, or 5 tons per axle of each driving wheel. If I adopted the system of separate locomotives, I could only do so by devoting one of the links of my carriage to the electrical machinery, and in this link could be placed at the same time the luggage. The result would be as follows :—I should have carriages with four links—three links being devoted to the passengers, and therefore capable of carrying 120 people, weighing when loaded 47 tons, and one link carrying the electrical machinery and representing the electrical locomotive, which would weigh at least 33 tons, including the machinery and the luggage placed in that compartment, giving a total weight of 80 tons at least for the whole carriage, able to carry 120 passengers. But the power produced by the motors, which could be placed on the four axles of the locomotive link, would not exceed 800 horse-power, or one-half the power produced by the arrangement I propose to adopt. The most serious result, however, would be that the four axles of the locomotive link would have to carry over 8 tons per axle instead of 5 tons, as in the present proposal, and for that reason it would be necessary to more than

double the weight of the line itself, and this increased weight would be especially objectionable at such high velocities as are contemplated, as it would increase the cost and difficulties in an enormous proportion. It would also diminish the available power to such an extent to be practically insufficient for the work to be done.

These enormous disadvantages are counterbalanced in my proposal by the possible disadvantage of having machinery in close proximity to the passengers. But there are means to deaden the sound and render this disposition of the machinery so far noiseless, as certainly not to be any more objectionable than the noise produced in the ordinary trains.

The generating stations would be constructed on the same principle as that of the electrical overhead railway at Liverpool; but the conductors would essentially differ from any conductors on any existing line, as they would be completely isolated on the whole length of the line, so as to be inapproachable by anybody, and the return current would also pass through similar conductors, absolutely isolated and protected. This renders the use of very much higher tension currents possible than are employed on the existing electrical railways. Another important point is ventilation. Though the carriages are lighted by sheets of plate glass, which are fixtures, the ventilation will be much more perfect than in the existing railway carriages. A sort of tunnel is formed between the two halves of the carriage, placed on either side of the centre rail, in which also the electrical machinery is contained. This tunnel is hermetically closed at the end facing the direction in which the carriage travels, but is open at the back. It is, therefore, always filled with a column of air, which is practically stationary. This air enters the carriages at the bottom, and escapes at the top, by an aperture inclined in the direction opposite that in which the carriage travels. Thus the carriages will be effectually ventilated without the necessity of windows being opened, and at the same time the column of air in the carriage and tunnel is entirely uninfluenced by the rapid travelling of the carriage, though constantly replenished.

This arrangement has also the advantage, which exists on no other electrical railway, of protecting completely the machinery from the influence of the outer air and dust, and at the same time leaves sufficient space for the electricians attending the train to move along the tunnel while the train is travelling, to constantly inspect the machinery, and to see that it is always in good order.

In considering the necessities of ventilation, and also the impossibility of placing passengers opposite each other in any train travelling at such high speeds, it will be seen that even if ordinary railways with two rails could be adapted to such high speed travelling, the carriages on such railways would practically have to be built somewhat after the fashion of the Lartigue carriage, to provide for the proper seating of the passengers, and for the air tunnel in the centre of the carriage, which is absolutely indispensable for proper ventilation. And this seems to me an additional proof of the advantage of building such lines on the single rail system as I propose.

It has also been mentioned in several quarters that it seems rather premature to attempt such high speeds by electricity when so much still remains to be done to adapt this means of propulsion with economy to ordinary tramways and railways, and that it might be better to begin by doing this as more urgently required. But in conclusion I wish to state why I differ from this view. Tramways are certainly a necessity, and so are ordinary railways, but these necessities can be provided for, and are provided for, without the application of electricity, so as to answer the wants of the *public* in that respect. Tramways are very effectually worked by horses, steam, and cables, and the railways worked by steam must in many cases always remain more economical than electrical railways. The wants of the *public* do not suffer through the inability to apply electricity to these two modes of locomotion; it is more the desires of the *electrician*. It is of special importance to persons interested in electricity or to companies or individuals, who think they might succeed in working at a more remunerative rate, if the application of electricity to these was more perfected. But the *public* consider the question from the point of view of convenience of locomotion, and do not suffer in any palpable degree from the want of electrical tramways or railways, as it is even very doubtful if any possible economy to be effected would much contribute to lower fares, instead of increasing dividends to shareholders only. But the desire, if it exists, as I think I have shown in the beginning of this paper, for more rapid locomotion remains unsatisfied at present, and, as far as I have been able to understand the question, appears in the present position of mechanical and electrical science only capable of being satisfied by the application of methods of a character similar to the one which I have endeavoured to lay before the public in this paper, and in my pamphlet on "Lightning Express Railway Service."

F. B. Behr.

November, 1893.

THE NEUTRALISATION OF SELF-INDUCTION BY CAPACITY.*

BY ALEXANDER D. LUNT.

IN alternating current circuits containing resistance, self-induction and capacity, in series, the phase of the current with respect to the impressed E.M.F. is determined by the relative values of the capacity and self-induction. The self-induction tends to retard the phase of the current so as to lag behind that of the impressed E.M.F. The action of the condenser causes exactly the opposite effect, so that, by a proper proportioning of capacity to self-induction, the circuit may be made to act as though it contained resistance only.

The following solution of the problem is believed by the writer to be simpler and less involved than those usually given, and, as such, is of interest:

Let

e = impressed harmonic E.M.F.
i = current.
C = capacity.
L = coefficient of self-induction.
ω = angular velocity = $2\pi n$, where n = periodicity.
R = resistance.
t = time.

The equation of E.M.Fs. is readily written:

$$e = \mathrm{R}\,i + \mathrm{L}\frac{d\,i}{d\,t} + \int\frac{i\,d\,t}{\mathrm{C}}.$$

Differentiating to free from the integral:

$$\frac{d\,e}{\mathrm{L}\,d\,t} = \frac{\mathrm{R}\,d\,i}{\mathrm{L}\,d\,t} + \frac{d^2\,i}{d\,t^2} + \frac{i}{\mathrm{L\,C}}.$$

To fulfil the conditions, it is required that

$$e = \mathrm{R}\,i$$

and

$$d\,e = \mathrm{R}\,d\,i.$$

Substituting,

$$\frac{\mathrm{R}\,d\,i}{\mathrm{L}\,d\,t} = \frac{\mathrm{R}\,d\,i}{\mathrm{L}\,d\,t} + \frac{d^2\,i}{d\,t^2} + \frac{i}{\mathrm{L\,C}};$$

but

$$i = \mathrm{I}\sin\omega\,t$$

$$\frac{d\,i}{d\,t} = \omega\,\mathrm{I}\cos\omega\,t$$

$$\frac{d^2\,i}{d\,t^2} = -\,\omega^2\,\mathrm{I}\sin\omega\,t.$$

Hence $\omega^2\,\mathrm{I}\sin\omega\,t = \frac{i}{\mathrm{L\,C}}$

and

$$\omega = \frac{\mathrm{I}}{\sqrt{\mathrm{L\,C}}}.$$

This last may be written

$$\mathrm{T} = 2\pi\sqrt{\mathrm{L\,C}}$$

(where T is the time of one period).

These conditions represent the required relations of capacity to self-induction in order to annul the effects of self-induction.

* New York *Electrical World*.

NOTES.

Closing of the Chicago Exhibition. — The various ceremonies connected with the closing of the World's Fair were performed on Monday last. Now that the Exhibition is closed and the Mayor brutally murdered, it is said that Chicago is comparatively a city of mourning.

To those Whom it may Concern.—We have received the following suggestive letter from the E.P.S. Company, and when we characterised it as improper, impertinent, and as certainly requiring an apology to us, also a visit, the reverse of pleasant, from Mr. Frank King, who talked in the same strain as the language in which the letter is couched, only more so:—

London, *October 27th*, 1893.

In your issue of the 20th there is an article on "Accumulators up to Date," which appears to be an editorial, and is therefore calculated to give the impression that the editors of the ELECTRICAL REVIEW have themselves carried out experiments over five months on a certain type of accumulator, the subject matter of the article. We, however, presume that this is not the case, and in justice to the trade generally, and ourselves in particular, we think you should at once rectify the error. As you are aware, our Mr. Butler has endeavoured to see Mr. Gatehouse on several occasions, and we regret to get your memo. to the effect that you decline to make an appointment.

ELECTRICAL POWER STORAGE COMPANY, LIMITED.
J. W. BARNARD, *Secretary*.

We may add that the Mr. Butler referred to was not denied an appointment; it was simply explained in writing that the time of one of us was taken up, and probably would be for some days, on a matter of business to which we need not here refer, but which can be readily guessed, but that he might, if he so desired, call on Friday (the day named by the company), on the chance of finding us at liberty. Our report on the Epstein accumulators may be seen on another page; the letter we leave our readers to form their own opinions upon, simply remarking that Mr. King's frequently-expressed *personal* objections to any improvements in secondary batteries which are not E.P.S. will not prevent us from presenting them to the notice of our readers whenever the opportunity arises. Anyone is at liberty to challenge or to offer objection to our figures, and in this instance those of Professor Ayrton will be open to the same criticism, but we decidedly object to such insinuations as those contained in the above letter which we trust will not distress Mr. Epstein any more than it will cause us to swerve from what we consider our path of duty.

Our statement:—"In order to form our own opinion, we have carried out a series of rigorous tests on a number of Epstein cells over a period of five months, &c.," is surely plain enough even for Mr. King.

Indian Telegraphs.—The review by the Government of India of the operations of the Indian Telegraphs for 1892-93 is just published. During the year 2,405 miles of line were added to the system. The revenue shows an increase of £20,000 on private inland messages, and £15,000 on private foreign messages. There is a decrease of £15,000 in State messages. Efforts have been made to curtail these. For the past 10 years the growth in private traffic has averaged 13 per cent. annually in quantity, and 10 per cent. in value. The Department has made its first trial of fast speed telegraphs, Wheatstone's automatic apparatus having been used between Calcutta and Bombay at the rate of about 200 words per minute. The working of the Department, though slow and sure, has not been such as to entitle it to a high place among modern telegraph systems, and with the introduction of the automatic system, we shall hope to hear not only of a large increase of traffic from the additional facilities offered, but a decrease in cost of working from the economy which the system effects. An electrician will probably be sent out from England shortly on a five years' engagement, as the Director-General of Telegraphs considers that the Department will gain by importing a man who is educated up to the latest ideas in applied electrical science. Whether an accomplished electrician will find scope for his powers in a telegraph service, pure and simple, is open to question.

Electric Tramways in Madrid.—It has been decided to lay down in Madrid a line of electric tramways. It is said that the enterprise is largely in the hands of a certain German electrical company.

Holborn Town Hall Lighting.—We are glad to be able to correct a statement which we regret appeared in our issue of last week. We understand that the electric light at Holborn Town Hall is entirely satisfactory. The Metropolitan Electric Supply Company inform us that their Sardinia Street station has ample reserve plant for a large increase in their connections, and that at the present rate of progress, the plant will not be full for some time to come, and then additional machinery will be added as required.

An Heroic Motorman.—The present hero of Tacoma, says the *Street Railway Review*, is William Gilson, a motorman on the Point Defiance Street Railway, whose courage saved the lives of 14 passengers some weeks ago. Some unknown and unaccountably fiendish villain had piled rocks on the tracks of the Point Defiance line, derailing Gilson's car as it crossed one of the bridged gulches frequent on that road. The car ran heavily against the guard rail, over it, and directly against the side railing, finally tottering on the edge of the bridge, 100 feet above the bottom of the gulch. Gilson, instead of jumping as he might easily have done, stood by his car, reversed the current, and applied the brake, saving his passengers and car, just as the front platform projected over the edge of the bridge. The company has pecuniarily acknowledged his intrepid devotion to his duty.

Chloride of Lead Batteries.—A correspondent writes, and gives the following particulars on the sale of the assets of the French E.P.S. to the Laurent Cély Company, mentioned in the issue of October 6th. Legal proceedings were taken against all manufacturers of secondary batteries, Gadot, Rousseau, and the Laurent Cély Company (Société pour le Travail Electrique des Métaux). Gadot lost his case, as also did Rousseau, and these results frightened the Laurent Cély Company to such an extent, that having a long purse, they offered to compromise on the terms which are known to our readers; and, besides, they bought the works, plant and machinery of the French E.P.S. for £14,000. In this manner, the Laurent Cély Company now exacts from their late allies and co-sufferers the tribute which they yesterday would have had to pay to the E.P.S. It is very doubtful whether the English Laurent Cély Company will undertake to make similar arrangements with the parent E.P.S. Company.

Dental Electrical Appliances.—A recent paper, by Dr. A. R. Cooke, is devoted to a consideration of the use and maintenance of such electrical appliances as have proved of practical value in dentistry. He wisely does not enter upon the discussion of electrical theories, and prudently refrains from a comparison of the merits of special electrical installation as supplied by manufacturers. Five sources of electricity are designated as being of practical value, and of importance in the inverse order as named:—"1. Voltaic batteries; 2. Storage batteries; 3. The arc current; 4. Alternating incandescent; 5. Edison incandescent current." The last named is supplied at a voltage of 110, and "is easily reduced by means of lamps or rheostats run in series with other appliances," this is Dr. Cooke's ideal current, and is suitable for any and all appliances. He has little to say in favour of "painless extractions by electricity." The shock when the current is applied to the tooth is supposed to render the operation painless. With a sufficiently strong current, the victim might be quite as much interested in the electrical phenomenon as in the actual tooth drawing; but Dr. Cooke describes the practice as a fad which has had its day, anæsthetics having well supplied its place. Certain persons of notoriety, who advertise painless extractions by electricity, will bear in mind that dental science is better understood in America than anywhere else, and that Dr. Cooke is a leading light in that country. The electric cautery and the incandescent "mouth-lamp" are devices which are considered most useful adjuncts to the operating chair; but the electric motor has proved the most practical and important of all the electrical appliances that have been introduced into dental practice.

Preston Electric Lighting.—The Town Council at their last meeting, after much discussion, decided that it would be injudicious to extend the electric lighting at Preston at present.

Proposed Electric Lighting of St. Helens.—The St. Helens Corporation have had under consideration the question of supplying electricity for public lighting purposes. The subject was referred to a sub-committee, and it has now been decided to apply for a provisional order.

Electric Lighting at Manchester.—The subject of lighting the Manchester Assize Courts by electricity has recently engaged the attention of a committee of the County Council. For the present, however, it is considered advisable to continue the use of gas.

The Institution of Electrical Engineers.—At the first meeting to be held during the Session, 1893-94 (Thursday, November 9th), the following Paper will be read: "The Electrical Transmission of Power from Niagara Falls," by Prof. George Forbes, F.R.S., Member.

Aberdeen and Electric Lighting.—Experiments are to be carried out here to test the practicability of the electric light. Nine lamps are to be erected between the top of Justice Street and Union Bridge, and one lamp in Correction Wynd, at its junction with St. Nicholas Street. The experiment involves an expenditure of over £200.

Matrimonial Festivities.—The whole of the employés of the firm of Messrs. Davey, Paxman & Co., along with their wives, were entertained at a banquet given by the head of the firm on Wednesday last, in celebration of Mr. William Paxman's recent marriage. In the course of the musical arrangements, Mr. T. H. Harrison (the firm's London manager) contributed several vocal items.

The Pacific Cable.—The Canadian Government *Gazette*, commenting editorially upon the Canadian and Australian cable, says that if the section to New Caledonia is in the hands of a French company, the whole telegraphic connection between Canada and Australia by this cable will be placed in a similar position to the Suez Canal, that is to say, it will be good enough for commercial purposes, but worthless from a military point of view. It hopes, says the *Financial Times*, that the Governments of Australia and the Colonial Office, instead of remonstrating and recriminating, will enter upon a practical consideration of the cost of the new cable, and the hands through which it is to pass.

A New Journal.—At the commencement of the new year there is to appear a new threepenny monthly journal, which will be known as *Mechanics*. As is implied by the title, the paper will be devoted to subjects of special interest to workmen and draughtsmen, while, at the same time, it is intended to make it useful to employers. Advance announcements state that the journal will be conspicuous when compared with similar papers, for the absence from its columns of "algebraic equations, mysterious diagrams, and abstruse theories." The most modern ideas in mechanism of every class are to be put forward, and monthly prizes are to be awarded for schemes on suitable subjects.

The Interrupted Atlantic Cables.—In regard to this article, which we reprint from the *Railway News* of October 21st, we would ask the writer, who so unwarrantably refers in it to "Hooper's short-lived core," if it is not a fact that the 1869 French Atlantic Cable in question (which has cost over £214,000 in repairs), was made by the Telegraph Construction and Maintenance Company, and that "Hooper's core" was *not* used in its manufacture though the contrary would seem to be implied? The other interrupted cable (that of 1874) was spoken of by the Marquis of Tweeddale at the general meeting of the Anglo-American Telegraph Company as being a better one, and as having only been interrupted thrice. In this cable also Hooper's core was *not* used, the makers being the same as in the previous cable. There may have been mistakes both in the manufacture and financing of these cables, but at least it is only fair that the blame should be borne by those who deserve it.

Personal.—The Governors of the new Battersea Polytechnic have appointed Dr. Sumpner to the lectureship, and to be head of the electrical department, of that institution.

Fire.—A fire occurred on Monday at the Raleigh Club, 16, Regent Street, the cause, as officially stated, being fusion of the electric light wires.

Penrith and Electric Lighting.—The Board of Health are seeking power to borrow money for certain purposes, one of the items being £250 estimated cost of proposed provisional order for electric lighting.

Salford Electric Lighting.—The Local Government Board have sanctioned the application of the Town Council for power to borrow £32,000 for electric lighting purposes, the sum to be repaid within 25 years.

The New Secretary of the Post Office.—The Postmaster-General has appointed Mr. Spencer Walpole, Lieutenant Governor of the Isle of Man, to be Secretary of the Post Office, in the room of the late Sir Arthur Blackwood.

Haytien Telegraphs.—The Sociétés Française des Télégraphes Sous-Marins announce the opening of new offices at St. Marc, Gonaïves, Petit Goave, Miragoane, and Jacmel, in the Republic of Hayti. These offices are in communication with the general network through Port-au-Prince.

Lectures.—Before the Institution of Mechanical Engineers last week, Mr. Benjamin A. Dobson read a paper on the "Artificial Lighting of Workshops."

The fourth of the series of lectures on "Electricity" was given by Mr. A. E. Briscoe at the Peterborough School of Science and Art the other day.

Prof. J. A. Fleming delivered a lecture on "Magnets and Electric Currents" in the large Assemby Hall, Mile End Road, on 26th inst.

A Suggestion re Manchester Electric Lighting.—A correspondent of the *Manchester Guardian* suggests that now that the streets of Manchester are to be lighted by electricity, lamp-posts ought to be entirely abolished. He considers them "obstructions," "hindrances," deplores the fact that they are turned into "small newspaper shops," and recommends that brackets be fitted to buildings on either side of the road instead of the posts. Would the general body of householders be easily persuaded to fall in with the proposal? There are many forcible objections against what this correspondent says is a "much needed reform."

An Electric Car Catastrophe in America.—A telegram from Portland, Oregon, dated November 1st, reads as follows:—"An electric car on the Oregon City Tramway line, containing 30 passengers, went through an open drawbridge in Maddison Street this morning, and was plunged into Carpen River. So far as can be at present ascertained, 25 of the occupants of the vehicle have been drowned. A heavy fog was hanging over the city at the time, and the open drawbridge could not be seen. Great difficulty has been experienced in recovering the bodies of the victims. Only one has up to the present been brought to the surface. So dense is the fog that the water in the river cannot be seen from the bridge."

The Spite of Discharged Workmen.—One day last week, in consequence of certain irregularities on their part, the *employés* of Messrs. Collier, Marr & Co., who were engaged fitting up an installation at the Mosley Hotel, Manchester, were dismissed. Shortly after the men had left the building the electric lights were suddenly extinguished. The cause of this was that the men had torn the fuses connecting the wires with the Corporation main circuit from their sockets in the basement and on the ground floor. Fortunately a panic was avoided, but by the exposed ends of the wires life was endangered, although no accident actually occurred. Two of the men have deservedly been committed to gaol for a month with hard labour. They are thus well repaid for their malignant spite, which might have culminated very disastrously. Such actions as these on the part of workmen will not tend to produce confidence and tranquility between employers and employed.

Aberdeen Proposed Electric Tramway.—It is proposed that an electric tramway should be constructed from Castle Street to the proposed new carriage way at the sea beach.

Telegraphic Time.—The Italian Telegraph Department have adopted the hour of the meridian 15° east of Greenwich, being 10 minutes and 4 seconds in advance of the hour of the meridian of Rome.

Harness Serves the Writ.—Messrs. Lewis & Lewis, on behalf of the *Pall Mall Gazette*, have accepted service of a writ from Mr. Harness. Messrs. Lewis, in reply, have informed the plaintiff's solicitors that "our instructions are to give you every facility to bring this case on for trial as early as possible, and to add that in the event of these proceedings being delayed, we shall take such steps on behalf of the defendants as the law permits to compel the plaintiffs to proceed to trial."

NEW COMPANY REGISTERED.

Central American Public Works Company, Limited (39,820).—This company was registered on the 26th ult., with a capital of £100,000 in £10 shares, to acquire any real or personal property in Central America, or elsewhere; to obtain bonds and other securities; to undertake the liabilities of any bondholders; to purchase and construct wires and cables of all kinds for the purpose of telegraphs or telephones, to carry on the business of telegraphy in all its branches; to develop the resources of any land and property belonging to the company; and also to undertake the trades of brewers, maltsters, and corn merchants. The subscribers (with one share each) are: A. W. Higgs, 66, Ondine Road, East Dulwich, clerk; G. S. Bonney, 28 and 29, St. Swithin's Lane, E.C., shorthand clerk; A. H. Downey, 40, Highbury Hill, N., accountant's clerk; H. Robbins, 37, Osborn Road, N., cashier; A. D. King, 466, Seven Sister's Road, N., clerk: G. L. Richardson, High View Road, S.E., clerk; A. C. Taylor, 177, Upper Thames Street, E.C., printer. The number of directors is not to be less than two nor more than five. Qualification, £100. Remuneration to be determined in general meeting. Registered by Powell & Burt, 28 and 29, St. Swithin's Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Railway Automatic Electric Light Syndicate, Limited.—The address of this company is now at 37, Walbrook, E.C.

English Electric Manufacturing Company, Limited.—This company filed a notice on the 17th ult. to the effect that the registered office is now situated at 30, Stamford Street, Leicester.

English Electric Carbon Company, Limited.—The first return of this company shows that out of a capital of £10,000, in £10 shares, 641 shares have been taken up. A sum of £10 has been called on each of 56 of these, and £5 on the remaining 585. The total of calls received is £3,485.

Electric Fittings, Hiring, and Maintenance Company, Limited.—The return for this company, dated October 17th, 1893, shows that out of a nominal capital of £200,500, in 40,000 £5 and 500 £1 shares, only seven shares have been taken up, and that nothing has been yet paid.

CONTRACTS OPEN.

Bolton.—November 18th. For the supply and erection of switchboards, accumulators, connections, &c., for the Gas and Lighting Committee of the Bolton Corporation. Specifications, plans, &c., may be obtained on application to Mr. J. H. Rider, borough electrical engineer, Town Hall, Bolton.

Dewsbury.—November 17th. The Corporation invite tenders for work required in the erection of an electric lighting station within the borough. The whole of the works, including the erection of a long chimney, will be let in one contract.

Newport (Mon.)—November 20th. For the supply and erection of certain steam boilers, feed-water heaters, economiser, pumps, mechanical stokers, forced draught apparatus, steam, exhaust and water pipes, condenser, tanks, steam engines, driving ropes, oil filter, alternators for incandescent lighting, dynamos for arc lighting, switchboards, instruments, arc lamps and lamp-posts, cables, culverts, surface-boxes, junction-boxes, converters, converter-boxes, converter-cases, switches, fuses, meters; also day-load plant to consist of semi-portable engine, alternator and exciter and switchboard for the equipment of the municipal electricity works of the county borough, for the Electric Lighting Sub-committee of the Corporation of Newport. Plan of buildings, specification, &c., may be obtained from Mr. Robert Hammond, consulting engineer to the Corporation, at 117, Bishopsgate Street, London, E.C.

BUSINESS NOTICES, &c.

The Universal Electrical Directory (J. A. Berly's), now under the direct supervision of the proprietors, H. Alabaster, Gatehouse & Co., is in active preparation for the 1894 edition (13th year). This is a directory of the electrical trades embracing the whole Universe, and having no superfluous matter irrelevant to a directory it can be sent everywhere, carriage paid, for 4s. It is indispensable to all having business transactions in the electrical world, and once used cannot be done without. Advertise in it! Order it! It will prove the best outlay ever made.

Taunton Electric Lighting.—Dr. Fleming has forwarded to the Electric Lighting Committee of the Corporation his report on his improvements and additions to the electric lighting station. The report is divided into four parts: (1) The additions to the boiler plant; (2) the additions to the dynamo plant; (3) various small improvements required in the station, and especially the alteration of the steam piping; (4) the laying of the mains underground. He deals with these various points in an exhaustive manner. He reports that the two Babcock boilers now in use at the station are, as far as he can learn, in fair condition. Practically the whole boiler power in the station is under use at the time of heaviest load, and there is no other reserve boiler power in case one of the boilers breaks down; nor is there any possibility of extending the lighting without overloading the boilers. He therefore recommends the committee to put down an additional boiler, equal to 100 H.P., and this boiler should be devoted entirely to the arc lighting station. He recommends the acceptance of the tenders of Davey, Paxman and Co. for a steel economic steam boiler at the cost of £385, together with £50 for setting it. The next point on which Dr. Fleming lays stress is that it is absolutely necessary to put in at once a small alternator to take the load at times when it is very far below the full capacity of the two present alternators. He also recommends that to drive this machine an engine capable of undertaking about 40 H.P. will be required. Under these conditions he expects to produce a marked economy in the coal. He further recommends that a steel steam boiler should be placed in the Babcock boilers, to form a common steam reservoir. The result will be that the large steam-pipes in the engine-room will be abolished. He thinks that the present Willans engine, and also a Rushton and Proctor engine, require overhauling. The arc light machine also requires a number of small repairs. He points out the necessity of getting rid as soon as possible of the Elwell-Parker machine used for charging accumulators. Lastly, he deals with the supply of the current by underground conductors, and says it will be necessary for the committee at once to commence putting some of the lines underground, but it is necessary to do this on a systematic plan. He proposes to get rid of the small house transformers, or rather to keep them for what may be called the "pioneer" work, and to supply the central portion of the town from one common set of transformers, which are placed in positions called sub-stations. From these sub-station transformers, underground mains will proceed to each of the customers. Each transformer will have a high tension side to which current will be supplied by an underground high tension main from the central station, and the low tension side of the transformers will be furnished with three wires for the three-wire system of distribution.

A special meeting of the Town Council was held last week to settle the purchase of the electric light works by the Council. Cheques, amounting to £9,849 13s. 9d., were drawn in favour of the electric light company, who are the vendors of the works.

The Electric Lighting of Camberwell.—Mr. Manville, having been appointed by the General Purposes Committee of Camberwell to report to them as to the best means of introducing an electricity supply into the parish of Camberwell, the report having been presented and read, it was resolved that it should form the basis of a lecture. This was delivered at the Camberwell Vestry Hall on Thursday, October 20th. The lecturer dwelt upon the progress of electric lighting throughout the United Kingdom in the hands of local authorities, and the success which had, without exception, attended their efforts at the present moment. Referring

to the success that had been achieved at Glasgow, Mr. Manville said that the Corporation invested almost the same capital as St. Pancras in establishing their first electricity supply works, and in the short period of three months' working only just ended, the demand for electricity has been so great, and the commercial success so assured, that the committee are asking the Corporation for sanction to borrow further capital to extend their works. The utilisation of dust destructors was next adverted to. By means of slides, a large number of electricity supply stations were illustrated. The room was lit by means of high candle-power, and various incandescent lamps kindly exhibited by the Edison-Swan Company. The system of arc lighting, and the use of electric motors, were illustrated by means of apparatus lent by Messrs. J. G. Statter & Co. Various experiments were also shown, and a large and most interesting exhibition of cooking and heating by electricity, including ovens, grillers, kettles, curling tongs, frypans, radiators, &c., in actual work, was shown, by the kindness of Messrs. R. E. Crompton & Co. At the close of the lecture it was proposed that Mr. Manville be requested to repeat the lecture in a larger hall so that a larger number of the ratepayers might attend.

Accidents.—At the Portsmouth County Court William Smith, a bricklayer's labourer, sued to recover £50 damages from Mr. Thomas Warren Quick, builder and contractor. From Mr. Jones's opening remarks it appeared that on July 15th the plaintiff was at work on the electric lighting station in Gunwharf Road. Stones were being hoisted up to the top scaffold, and the plaintiff was standing on a lower scaffold guiding the stones. While the work was proceeding the rope stranded, and the men sent word to the foreman of the navvies, Mr. Parker. He directed that the rope should be spliced, but when work was renewed it broke about six feet above the splice. The stone fell on to the platform, and the plaintiff was hurled to the ground. He received injuries to the spine and head, which necessitated his removal to the hospital, and it would still be two months before he could do any work. Subsequently Mr. Quick offered to pay plaintiff his wages while he was laid up, but at the same time repudiated his liability, alleging contributory negligence. After a brief deliberation in private the jury found for the plaintiff, £30 damages. His Honour gave judgment for this amount with costs.

Mr. C. B. Callow, the resident engineer at Lord Rothschild's electrical works at the Park, Tring, met with a serious accident the other day through a short circuit causing a strong flash, which severely burned his right hand, literally scooping out the flesh in places on the thumb and one or two of the fingers.

Electric Lighting on H.M.S. Howe.—In connection with the refitting of the above battle-ship, it is stated that the only part of the work given by the Admiralty to outside contractors has recently been successfully completed by Messrs. King, Brown & Co., of Rosebank Electric Works, Edinburgh. This was the work of completely renewing the electric light and gun firing circuits, as, owing to the limited time available, the dockyard authorities were unable to take the work in hand themselves. The *Howe* is lighted by means of 520 16-candle incandescent lamps, in addition to the usual yardarm reflectors, masthead side and semaphore signalling lamps, cables also being led to four search light projectors; while the gun firing arrangement comprise electric circuits with the necessary batteries and firing keys for the four 63-ton barbette guns, for the six broadside guns, and for five torpedo tubes. Over 120 men were employed by the contractors, the work being carried on continuously day and night till its completion, which was effected within ten weeks from the date of order. The experiment of placing such a contract with a private firm has proved so satisfactory that the authorities contemplate taking the same course in connection with several other vessels at present refitting in Chatham dockyard.

Opening of Hymer's College, Hull.—On Monday last, the 30th ult., the Lord Chancellor opened the Hymer's College, Hull. The building consists of a spacious main hall, capable of holding 800 people, and around it are arranged 16 class rooms, including chemical and technical laboratory, and lecture rooms. After the opening ceremonies the chairman, Alderman J. T. Woodhouse, and Mrs. Woodhouse, held a reception in the evening, which was well attended. For the interest of the visitors, an electrical exhibition was held in the chemical laboratory. An effective display was made by the help of several l.nders of apparatus, amongst whom were Messrs. Crompton & Co., electric cooking and heating apparatus; the Postmaster of Hull, telegraphic instruments; Messrs. the Edison and Swan Company, lamps, models, motors, &c., and a gas engine and dynamo were fixed by Messrs. Roslyn & Mathews, of Hull. Electricity will be taught at the college, and, ultimately, the latter will generate its own current, it being distant from the mains of the corporation supply.

Price Lists, &c.—Messrs. Höveler & Dieckhaus of London and Papenburgh, have sent us particulars, in pamphlet form, of white anti-friction metals and tin alloys, which, we understand, are a speciality of theirs. At the World's Fair the company's tandem bearing metals were awarded the first prize (medal and diploma); they were the only firm of those exhibiting in the same section who were awarded for anti-friction metals.

Messrs. Wm. McGeoch & Co., of Berners Street, W., have lately published a list devoted to illustrated descriptions of all kinds of electric light fittings as supplied by them. Switches and cut-outs of all types, some of which are shown full size, have a number of pages devoted to them. Ceiling fittings, fuses, Unique switches (which the firm manufacture under license), lampholders, standards, wall brackets, and similar fittings, are all illustrated so well by blocks showing every detailed working part, that very little word-description is necessary. The book is a good collection of electric light fittings.

Infringement of the Factory Act.—At the South-Western Court on Tuesday, Mr. Denman heard three summonses against the Gülcher (New) Electric Light and Power Company, Wellington Road, Battersea, for failing to register the names of young persons employed, and to obtain certificates of fitness, and also for obstructing one of Her Majesty's inspectors in the execution of his duty. Mr. Jasper Redgrave, one of Her Majesty's inspectors, who conducted the prosecution, said the manager of the company refused to permit an examination of the young persons to take place. The inspector so obstructed was called, and said the manager told the lads not to answer questions put to them, and ordered witness off the premises, adding that if he did not leave in three minutes he would have him put out. The manager also prevented him from getting near the boys. The manager, who was in attendance, said he regretted the misunderstanding with the inspector. The story had been exaggerated. The inspector rushed into the factory, and his conduct was such that he demanded an apology. He denied that any obstruction took place. Mr. Denman said that unless the Factory Act was enforced the whole thing would be utterly useless. He imposed penalties amounting in all to £10, with £1 7s. costs.

Awards.—Mr. Frederic Nell has just received a communication from his company in the States announcing the fact that the first prize gold medal has been awarded to the "Victor" turbine at the Chicago Exhibition.

In the electricity department at the World's Fair, an additional award has been made to Great Britain, viz.:—The General Electric Company, Limited, for carbons. Two additional awards have been made to Germany and one to Italy.

The medal for the best flue feed water heaters has been awarded by the World's Columbian Exposition, to the Fuel Economiser Company, of Matteawan, N.Y., for the Green Fuel Economiser.

Alleged Infringement of Lamp Patents. — The Bazaar Committee of Glasgow Town Council had before them at their last meeting a letter from a London firm of solicitors, with reference to an alleged infringement of the patents of the Edison and Swan United Electric Lighting Company, Limited, by the use of certain incandescent electric lamps in the City Hall. The Town Clerk reported that, on receipt of the letter, he had, on behalf of the Corporation, repudiated liability, communicated the letter to Mr. Richard Miller, who supplied the lamps, and intimated that the Corporation must look to him to keep them scatheless in the matter. The Town Clerk had also asked Mr. Arnot, electrical engineer, to report on the communication, and a letter from him was submitted. The matter was remitted to the Town Clerk with power to take such action as he might consider expedient, in the event of a claim being pressed.

Medical Battery Company, Limited.—The *London Gazette* publishes notice of a petition which was filed on 27th inst., by Thomas Brooks Browne, of 163, Queen Victoria Street, advertising agent; and that the said petition is directed to be heard before Mr. Justice Vaughan Williams at the Royal Courts of Justice, Strand, on Wednesday November 8th, 1893; and any creditor or contributory of the said Company desirous to support or oppose the making of an Order on the said petition, may appear at the time of hearing by himself, or his Counsel, for that purpose. Messrs. Ingle, Cooper, & Holmes, of 20, Threadneedle Street, E.C., are the petitioner's solicitors.

Electric Light in Cotton Mills.—We learn that Messrs. Bennett & Druce, of Preston, have just completed an installation of 300 lamps at Mr. John Humber's mills, Bushell Street, Preston. The light is obtained from a dynamo driven by the existing mill engine, and burns with perfect steadiness. We understand that the current can be generated at a total cost of 1½d. per unit, which is equivalent to gas at 1s. per 1,000 cubic feet, and Mr. Humber will thereby effect a great saving on his previous gas bills, in addition to the advantages secured by using electric light. The same firm are also putting an installation into Messrs. Hartley Brothers' mills, Shelley Road, Preston.

The Electric Light at Whitehaven.—The electric light here is said to be making satisfactory progress. The trustees have decided to extend the area of supply for private lighting by laying a cable from the junction of Lowther Street and Scotch Street, along Scotch Street, Irish Street, James Street, Swingpump Lane, and Quay Street. The private connections so far number about 30, and the trustees have in hand several other applications. Messrs. Pattinson and Winter intend having their flour mill at the old barracks lighted by electricity. The lighting of the harbour will be completed shortly.

The Electric Light at the Agricultural Hall.—An instance of high tension series arc lighting by a gas engine can be witnessed at the Agricultural Hall, where 40 of the Electrical Company's Luna arc lamps are lighting the main hall of the above institution. The current is being supplied by a 50 H.P. Stockport gas engine, driving a Brush high tension dynamo. This is one out of many successful installations carried out by Messrs. Vaughan & Brown, who claim great things for their Luna lamps.

Govan Asylum Lighting.—A statement lately submitted to the Govan Parochial Board, shows that the cost of lighting Hawkhead Asylum by electricity would be £5,300, with an annual outlay of £635; by oil gas £2,810, with an annual expenditure of £282; and by Glasgow gas, £1,500, with an annual outlay of £200. The Board have resolved to introduce Glasgow gas.

Pontypool Electric Lighting.—It has been decided to ask the Pontypool Electric Light and Power Company for their quotation for erecting and supplying four lamps in conspicuous quarters of the town, also to state the probable cost for the electric energy per quarter. The company have been asked to submit the same before the next meeting of the Local Board.

The Electric Light in Salisbury.—Mr. S. Parker has commissioned Messrs. Roger Dawson & Co., of Berners Street, London, to lay down private electric lighting plant. By the medium of this, his own premises will be lighted, also those of Mr. Maurice Parker. A Mr. Laming, fancy draper, is also connected with the enterprise. Nine 16 C.P. incandescent lamps will be fitted in Mr. Laming's shop and showroom, and there will be an arc lamp of 1,000 C.P. suspended outside. There will also be an arc lamp outside Mr. S. Parker's premises, and a group of three 200 C.P. power lamps outside the shop of Mr. Maurice Parker.

Drake & Gorham.—We understand that owing to the increase in their business, Messrs. Drake & Gorham have found it necessary to extend their office accommodation. It would seem that notwithstanding the competition in cheap work there is still a considerable demand for thoroughly reliable work carried out at a reasonable rate.

Moss Side Electric Lighting.—The *London Gazette* states that the Collier-Marr Telephone and Electrical Manufacturing Company, Limited, of Manchester, have applied to the Board of Trade for a license for the supply of electrical energy for public and private purposes within the area of the Moss Side Local Board District.

Blackburn Electric Lighting.—The temporary installation is expected to be completed in February next. It will comprise four dynamos, two 120-kilowatt, and two 45-kilowatt; two batteries of accumulators, each consisting of 60 cells capable of supplying 300 ampères for 3½ hours. The price to be charged is 6½d. per unit.

Kensington Electric Lighting.—A special meeting of the Vestry was held the other day to consider the following resolution: "That the Vestry apply to the Board of Trade for a provisional order authorising the Vestry to supply electricity within the district over which it exercises jurisdiction."

Camberwell and Electric Lighting.—A special statutory meeting of the Camberwell Vestry is to be held on Wednesday, December 6th, to consider the advisability of applying for a provisional order. An electricity committee has been appointed.

Railway Station Lighting.—Some extensive alterations have been carried out at the Central Railway Station, Newcastle. Electric lighting figures among the improvements, the fittings for which were supplied by Messrs. Charleton & Co., of Newcastle.

Lynton Electric Lighting.—Mr. Benn has intimated to the Lynton Local Board that he is about to apply for a provisional order in connection with the electric lighting works. The Board decided to take no action until the order was presented.

Extensions at Chatham.—The directors of the Chatham, &c., Electric Lighting Company, have decided to issue £12,000 worth of debenture shares, the money being required for the extension of the company's mains.

City Electric Lighting.—Messrs. S. Burnby & Son have completed the installation of 5 16-C.P. lamps (using the Bradner adjustable hanger), at the offices of Mr. Donald McMillan, 11 and 12, Clement's Lane, E.C.

Electric Light at Ealing.—A Local Government Board enquiry was opened last week with reference to an application by the urban authority for permission to borrow £25,000 for purposes of electric lighting.

The International Cable Company, Limited.—Mr. Frederick Samuel Lucey, of 3, Bucklersbury, E.C., has been appointed official liquidator of the above-named company, in the place of John Lord, deceased.

Pontardawe and Electric Lighting. — Messrs. W. Gilbertson & Co., Limited, of Cardiff, have applied to the Board of Trade for a license to light certain streets in Pontardawe with the electric light.

The Phonopore.—Last Monday, in the telegraphic classroom of the Birmingham Municipal Technical School, Mr. Whitehouse, the instructor in telegraphy, gave a lecture on the phonopore.

Griffiths Brothers & Co.—"Anti-sulphuric enamel," as supplied by this firm, is being employed for the protection of metal and woodwork from acid fumes in the central station at Brussels.

Agency.—Messrs. Paterson & Cooper have been appointed agents for the sale of Messrs. Richard Frères' electrical and industrial measuring instruments for the United Kingdom.

Club Lighting.—A new constitutional club and concert hall is to be erected at Newport. It is proposed to introduce the electric light.

Library Electric Lighting.—The reading room of the Norfolk and Norwich Library is to be lighted by electricity at a cost of about £100.

Lighthouse Lighting.—A project is on foot to have electric light fitted in the old Head of Kinsale lighthouse off the County Cork.

Dewsbury Electric Lighting.—The Local Government Board have sanctioned the borrowing of £25,000 for electric lighting purposes.

Portsea and Electric Lighting. — The guardians' offices in St. Michael's Road are to be lighted by electricity.

CITY NOTES.

Monte Video Telephone Company.

THE annual general meeting of the Monte Video Telephone Company, Limited, was held on Tuesday at the offices in Gresham House, Old Broad Street, E.C.

Mr. HERBERT WARD presided, and in moving the adoption of the report, said that during the year ended July 31st last, their net profits amounted to the sum of £6,895, which was about £500 more than the net profits of last year; but it must be remembered that last year's profits showed an increase of £1,622 over the previous year, so that there was no doubt that the company's operations in Monte Video continued to make satisfactory progress, notwithstanding the prevailing hard times in Uruguay. The strictest economy had been observed in all matters relating to the general working of the company. The central office building in Monte Video had now become the unencumbered property of the company, the last instalment of the purchase money having been paid on March 6th last, since which time they had received regular monthly drafts from the manager. One of the directors had only just returned from Monte Video, and he was thoroughly satisfied with the manner in which their business was conducted by the manager and his staff, and also with the condition of the company's property. The number of paying subscribers was now 1,383, showing an increase for the year of 53, and, with a return to more normal conditions in commercial circles generally in Uruguay, there was no doubt that number would be substantially increased. The board had to announce that the committee of the London Stock Exchange granted, on June 12th last, an official quotation to the company's preference and ordinary shares.

Mr. C. H. SANDFORD seconded the motion.

A long discussion followed, in the course of which Mr. Lock, Mr. Touch, and Mr. Praed found fault with the directors for not declaring a dividend on the preference shares out of the profits that had been earned, as was done on the last occasion, instead of placing the same to the reserve and depreciation fund.

The CHAIRMAN stated, in reply, that the board had been informed that it was illegal to declare a dividend on the preference shares at present.

After further discussion, Mr. TOUCH moved an amendment to the effect that the report and accounts be referred back to the board, in order that they might recommend a dividend of 3 per cent. to the holders of the new accumulative preference shares of the company, they agreeing to lend the amount until the company was in a position to repay the same, with interest.

The amendment was seconded and lost.

A poll was demanded, which resulted in the amendment being negatived and the report adopted.

After the re-election of Mr. E. F. Powers, Mr. Jones was elected a director of the company.

International Okonite Company.

AN extraordinary general meeting of this company was held last Friday, at the Cannon Street Hotel, E.C., for the purpose of considering resolutions changing the name of the company to the Okonite Company, Limited, and making alterations in the articles of association.

Mr. SAMUEL POPE, Q.C., presided, and explained that the meeting was convened by the directors in response to the request of a very large body of the shareholders of the company. At the last general meeting the directors expressed considerable hope that they would be able so to arrange the business at the Manchester factory that it might be turned from a losing into a profitable concern. They did their best, but they found that in order to put it on a sound footing it would be necessary to appropriate a certain amount of working capital to that department of the business. The branch in America was being conducted at a considerable profit, but the revenue made there was liable to be depleted by any losses which occurred in carrying on the business on this side. That fact, and the general financial situation in America, had induced both the American and English boards to reluctantly come to the conclusion that the proper course to adopt, if the Manchester factory could not be worked profitably, was to cease business in England. He could not say absolutely, but almost, the whole of the English liabilities had been arranged, and the property of the company here was practically unencumbered. The effect of the amendments to the articles of association would be that the existing board in England would cease; but a certain number of directors would be elected to study the interests of shareholders in this country. The chairman concluded by moving the resolutions.

Mr. SHORT, the representative of the American board, seconded the motion, and explained the methods of the company in America, and described the effect of the present financial crisis. If the amendments were passed the company could, he thought, be made a success.

Mr. SHAW moved the following addition to the first amendment: "Provided that the funds of the company should not be expended or lent upon the purchase of its own stock."

Mr. CLEMENTS, the agent for the American shareholders, said he held proxies for more than 16,000 shares, and his instructions were to vote only for the amendments as proposed.

Mr. F. L. RAWSON objected *in toto* to the amendments being passed, as the measure would place the company entirely at the mercy of the American shareholders. It was necessary that it should be carried with a three-fourths majority, and he felt certain that if shareholders on this side were consulted, more than the requisite fourth could be obtained to defeat the project. The Americans would then be more disposed to reconsider the first amendment to the articles.

Mr. Shaw's amendment was seconded and supported, there being a very strong expression of opinion as to the advisability of passing the amendment to Article 35 as proposed.

At the invitation of Mr. CLEMENTS, however, who undertook to represent everything fairly to the American shareholders, Mr. Shaw withdrew his opposition, subject to his right, through Mr. Clements, to forward his reasons to the proper quarter in America. The latter gentleman also engaged to send to America any other objections that might reach him.

The resolutions were then put and carried, with a few dissentients.

The Continental Edison Company.

THE report of the above company just issued, after explaining the appropriation of the share capital and other matters already known, states that the company has the lighting of one of the most important sectors of Paris, including the galleries of the Palais Royal, the Elysée and Industry Palaces, and a number of theatres, &c. It has three central stations, and the progress of production, notably at the Faubourg Montmartre station, since 1888, has been as under:—December, 31st, 1888, 3,863 lamps; December 31st, 1889, 11,493 lamps; December 31st, 1890, 23,093 lamps; March 31st, 1891, 29,782 lamps; March 31st, 1892, 43,942 lamps; and on March 31st of this year, 58,278 lamps. While two of the company's stations show an increase, that of the Palais Royal showed a decrease last year. In order to make up for this deficiency, the company is endeavouring to seek outside a more perfect utilisation of the motor force which it has at its disposal at that station, and with that object in view it is now studying an extension of the public lighting of the Tuileries Gardens. In 1890 the company was chosen to light the French Exhibition at Moscow, and in 1892 it was recognised in Russia, where its central station at Odessa has been working since November last. In 1892 the balance-sheet under the heading "Installations and electricity stations," showed an increase of 737,041 francs, arising from the complement of the installations and canalisations, their estimate being divided thus:—Edison sector, Paris, 5,889,459 francs; Palais Royal station, 1,160,230 francs; Lille station, 114,178 francs; Odessa station, 32,763 francs; various theatres, 1,117,475 francs. The net profit for 1892 was a little lower than that of the preceding year, accounted for principally by the decreased profits on the sale of electrical material. The following are the profit and loss accounts for the last four years:—

EXPENSES.

	1889. Francs.	1890. Francs.	1891. Francs.	1892. Francs.
General expenses ...	263,644	215,329	283,121	196,886
Legal	17,722	16,796	7,868	3,937
Expenses of patents	10,404	7,001	9,716	7,359
Service of obligations	—	—	89,335	124,123
Amortisations ...	430,403	353,509	263,138	506,270
Special reserve ...	—	—	30,000	—
Miscellaneous ...	11,572	17,960	20,149	9,441
Moscow Exhibition ...	—	—	44,474	—
Net profit	349,177	424,466	437,251	401,462
	1,082,922	1,035,061	1,185,052	1,249,478

RECEIPTS.

	1889. Francs.	1890. Francs.	1891. Francs.	1892. Francs.
Interest and exchange	20,122	28,394	19,287	9,573
Rents	75,353	—	—	—
Realisation and revenue of shares...	90,385	103,432	72,668	46,038
Profits and sale of material	229,117	382,353	246,734	166,051
Profits on working ..	667,945	503,959	819,950	954,223
Miscellaneous ...	—	16,923	26,413	73,593
	1,082,922	1,035,061	1,185,052	1,249,478

The profits of the company have allowed of the following declarations of dividends:—

	Shares. Francs.	Founder's shares. Francs.
1887	35	5·01
1888	20	3·61
1889	22·50	4·83
1890	20	4·60
1891	20	4·78
1892	20	5·36

In commenting upon this report in its financial article, a Parisian contemporary says:—"In short, the situation of the Continental Edison Company is good. Now that it has given up the manufacture of electrical machinery and devoted itself to lighting, it is in a better position. It is, however, to be regretted, both for the public and its shareholders, that it has not hitherto been able to obtain from the authorities an extension of the concession, which would permit it to lower its prices, and also to reduce its amortisations, which are larger as the duration of its concession is shorter. Under the heading of expenses of 848,000 francs, amortisations figure for more than 500,000 francs. When will our municipal councillors understand that the public interests are connected with those of the companies holding the concession for a public service, and the more the companies are restricted in their working, the less sacrifices can they make to the profit of their customers?"

Eastern Extension Telegraph Company.

THE fortieth ordinary general meeting of this company was held on Wednesday at Winchester House, Sir John Pender presiding.

In moving the adoption of the report and accounts, the CHAIRMAN stated that the gross revenue for the half-year ended June 30th last had been £257,986, or £10,998 in excess of that of the corresponding period of 1892; while the working expenses had been £78,229, showing a decrease of £1,052. The usual interim dividends at the rate of 5 per cent. per annum had been paid for the past half-year, amounting to £62,500, and the balance of £81,116 had been carried forward, as against £70,271 for the corresponding period of 1892. The second year of the Australian tariff guarantee arrangement expired on April 30th last, when it was found that the loss for the year had been £43,558, as compared with £55,040 for the first year of the guarantee. One-half of this loss, or £21,779, had been made good by the guaranteeing Governments, and the remainder had been distributed between their company and its partners in the pool. During the current or third year of the guarantee the loss would, as far as they could at present judge, be comparatively nominal, owing to the additional 9d. that was added to the tariffs at the request of the colonies having come into force January 1st last, and to the abnormally large traffic that was carried a few months ago when the bank reconstruction schemes were being arranged. With regard to the cable recently laid by a French company between Queensland and New Caledonia, its promoters claimed for it that it was the first link of the much-talked-of Pacific cable between Australia and Canada. It had been laid under a guarantee arrangement with the Governments of France, Queensland, and New South Wales, the two colonies giving a subsidy of £2,000 a year each, and the French Government giving a guarantee of something like £8,000. After the strong opposition which had been displayed to this cable, both in the colonies and on this side, it was not likely to be anything more than a local line, and as a local line it ought to be a small feeder to this company's system. He might mention a fact which should be a lesson to those who had no experience of cables, and it would afford such persons the opportunity of learning from those who had such experience. Only last week both of the company's Fort Darwin cables became interrupted within a few hours of each other, many hundred miles apart, and but for their third cable to Western Australia the colonies would have been entirely cut off from telegraphic communication. Fortunately they had a repairing vessel available close by, and within a few days they hoped that both cables would be repaired; but similar troubles, arising from inequalities of the bottom and from coral landing-places, would most certainly occur in the Pacific, making it absolutely necessary to provide a duplicate line, with, at least, two maintenance ships and a large sinking fund, obtained from earnings, to replace the cable within a reasonable period. Negotiations had been in progress for a good many years for strengthening the China section of the company's system, and with this object they had, for the last 10 or 12 years, been working, not only with the Colonial Office, but with the Straits Government and Hong Kong. They had endeavoured to obtain a concession with some subsidy for the work they proposed to do.

The motion was seconded by the MARQUESS OF TWEEDDALE, and carried unanimously; and a vote of thanks to the chairman and the directors then terminated the proceedings.

The Aluminium Company.

IN their report for the 12 months ended June 30th, the directors of the Aluminium Company, Limited, state that the hopes they expressed in the last annual report, that a time of greater prosperity for the company was at hand, have not been disappointed. The Oldbury trading account shows a profit of £7,245, but this amount was not quite sufficient to meet all fixed charges at the head office, including debenture interest. The volume of the company's business has increased very rapidly during the last few months. The directors think this a suitable time to rearrange the capital, and at the extraordinary meeting a resolution will be proposed to write off £4 per share, thereby reducing the nominal value £1 per share. The directors believe that the present income of the company will be sufficient to meet all fixed charges, to provide adequately for depreciation, and to leave a balance for dividend on the reduced share capital.

The Western and Brazilian Telegraph Company, Limited.—The board of this company state that owing to the critical state of affairs in Brazil they will be unable to recommend a dividend for the half year ended June 30th last. They have placed £12,000 to reserve fund, and propose to carry forward £7,679 to the current half-year.

The Electric and General Investment Company, Limited.—The directors have declared an interim dividend on the capital paid up on the ordinary shares of the company at the rate of 10 per cent. per annum for the six months ending November 30th, the dividend to be payable on and after December 1st next.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 29th, 1893, amounted to £848; week ending October 30th, 1892, £889; decrease £41; total receipts for half-year, 1893, £13,766; corresponding period, 1892, £13,509; increase £257.

The Cuba Submarine Telegraph Company. The estimated traffic receipts for the month of October were £3,000; as compared with £3,539 in the corresponding month of last year.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 27th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,704.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation October 25th.	Closing Quotation, November 1st.	Business done during week ended November 1st, 1898. Highest.	Lowest.
184,500£	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 —103	100 —103	...	...
1,134,640£	Anglo-American Telegraph, Limited	Stock	43 — 45	45 — 47	46½	44½
2,932,680£	Do. do. 6 p. c. Preferred	Stock	80 — 82	83 — 85	85	80½
2,932,680£	Do. do. Deferred	Stock	7⅛ — 8	7⅞ — 8¼	8⅜	7⅞
130,000	Brazilian Submarine Telegraph, Limited	10	12 — 12½	11⅞ — 12¼	12⅛	11⅞
18,700£	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000£	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	107 —111	107 —111	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅞ — 3⅛	2⅞ — 3	...	...
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ — 2⅜	2⅛ — 2⅜	2⅜	2¼
125,000£	Do. do. 4½ per cent. Debenture Stock	Stock	107 —109	107 —109	107½	107
20,510	Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000	5	4⅜ — 5¼	4⅜ — 5¼	...	...
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	2 — 3	2 — 3	...	...
630,000£	City and South London Railway	Stock	30 — 35	28 — 33	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	11¼ — 11⅝	11¼ — 11⅝	11⅝	11 11/16
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	12⅜ — 13¼	12⅜ — 13¼	13⅛	12 15/16
10,000,000$	Commercial Cable, Capital Stock	$100	135 —140	135 —140	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	10/-	1/16 — 3/16	1/16 — 3/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	3¼ — 4¼	3¼ — 4¼	...	...
50,000£	Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	96 —101	96 —101	...	...
16,000	Cuba Telegraph, Limited	10	11½ — 12¼	11½ — 12½	12⅜	...
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18 — 19	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ — 3½	2½ — 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	8½ — 9½	8½ — 9½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11 — 11½	10⅞ — 11⅛	11¼	10 15/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅜ — 15	14⅜ — 15	15	14⅜
70,000	Do. 6 p. c. Preference	10	15½ — 16½	15½ — 16½	16 1/16	...
105,900£	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	108 —111	108 —111	...	...
1,294,100£	Do. 4 p. c. Mortgage Debenture Stock	Stock	115 —118	113 —116 xd	116	114½
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15 — 15¼	15 — 15¼	15¼	15
62,700£	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	...	...
222,800£	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	...	...
320,000£	Do. 4 p. c. Debenture Stock	Stock	113 —116	113 —116	...	...
108,700£	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104	...	...
146,800£	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	101 —104	...	...
300,000£	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	...	...
200,000£	Do. 4 p. c. Reg. Mt. Debs. (Mauritius Subsidy) 1 to 8,000	25	104 —107 %	104 —107 %	...	...
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	1⅝ — 2¼	1⅝ — 2¼	...	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/16 — 1/16	1/16 — 1/16	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	1/16 — 1/16	1/16 — 1/16	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1/16 — 1/16	1/16 — 1/16	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	¼ — 1½	¼ — 1½	...	...
180,227	Globe Telegraph and Trust, Limited	10	8⅝ — 8⅞	8⅝ — 8⅞	9 1/16	7
180,042	Do. do. 6 p. c. Preference	10	15 — 15½	14⅞ — 15	15½	14 15/16
150,000	Great Northern Tel. Company of Copenhagen	10	20 — 20½	20 — 20½	...	...
200,000£	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	103 —106	103 —106	...	...
12,134£	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ — 5½	4½ — 5½	...	...
9,600£	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6 — 7	6 — 7	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½ — 22½	21½ — 22½	21⅝	21½
200,000£	Do. do. 4½ p. c., Deb., 1896	100	101 —103	101 —103	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 44	40 — 43 xd	42	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	1 — 2	1 — 2	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4½ — 4⅝	4½ — 4¼	4 7/16	4 5/16
15,000	Do. do. fully paid	5	6 3/16 — 6 7/16	6 — 6¼	6½	5⅝
37,500	Liverpool Overhead Railway Ordinary, fully paid	10	5⅝ — 5⅝	5½ — 5⅝	8½	4⅜
6,295	Do. do. Pref., £6 paid	10	6 1/16 — 6 3/16	6 1/16 — 6 1/16	6⅛	...
37,548	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000£	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	...	..
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	7 — 7½	7½ — 7⅝	7½	7½
50,000£	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	104 —107	104 —107	...	...
15,000	Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ...	5	1½ — 2½	1½ — 2½	...	...
28,000	Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid	5	3 — 4	3 — 4	...	...
484,597	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜ — 4⅞	4⅜ — 5	4⅞	4 13/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	13½ — 14½	13½ — 14½	14⅜	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13½ — 14½	13½ — 14½	...	...
119,234	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5⅛ — 5⅛	5⅛ — 5⅛	5⅜	...
726,477£	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —115	113 —115	114	113¼
48,800	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,452	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 — 6	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16 — 5/16	3/16 — 5/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000	100	102 —105	102 —105	...	...
11,802	Reuter's Limited	8	5½ — 6½	5½ — 6½	...	...
19,980	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	6 — 6½	6 — 6½	...	...
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8¼	...
3,381	Submarine Cables Trust	Cert.	113 —118	113 —118	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	2 — 2⅛	2 — 2⅛	...	...
37,350	Telegraph Construction and Maintenance, Limited	12	32 — 34	32 — 34	...	...
150,000£	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2 — 2⅛	2 — 2⅛	...	...
146,370£	Do. do. 5 p. c. Debenture Stock ...	Stock	90 —100	90 — 100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½ — 6½	5½ — 6½	...	...
260,900£	Do. do. do. 5 p. c. Debentures	100	98 —101	98 —101	...	...
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	...	...
150,000£	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	99 —103	99 —103	100⅛	99½
64,242	Western and Brazilian Telegraph, Limited	15	6⅜ — 7⅛	5⅞ — 6⅛	6⅛	5⅝
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5 — 6½	5½ — 5⅝	5⅝	5½
33,129	Do. do. do. 5 p. c. Deferred	7½	1¼ — 1⅝	1 — 1⅞	...	...
178,200£	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 —106	103 —106	...	...
222,700£	Do. 5 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	...	..
88,321	West India and Panama Telegraph, Limited	10	1⅛ — 1⅜	1⅛ — 1⅜	1⅛	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10 — 10½	10 — 10½	10⅜	10 1/16
4,669	Do. do do. do. 6 p. c. 2nd Preference ...	10	9 — 10	9 —10	...	...
80,000£	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	106 —109	106 —109	...	...
$1,214,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	115 —120	115 —120	119	..
169,000£	Do. do. 6 p. c. Sterling Bonds	100	102 —105	102 —105	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5 — 5½	5 — 5½	5 7/16	5 5/16

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5—5¼.—Brush Company, 4½ per cent. Debenture Stock, issued at 1 per cent. premium, 100—103.—Electric Construction Corporation 6 per cent. Debentures, 96—98.—Electric and General Investment, shares of £5 (£1 paid), 1½—2½.—Founders' shares, 200—225.—Electricity Supply Corporation, Ordinary of £5, 5—5¼.—House to House Company (£5 paid) 1¼—2¼.—Do. 7 per cent. Preference of £5, 5—5¼.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅜—5⅝, 1st Preference Cumulative 6 per cent., £5 (fully paid 6—6¼.—Manchester, Edison and Swan Company £9 (£1 paid), 4—4¼.—Queen Anne's Mansions Lighting and Heating 6 per cent. £100 Debentures, 101—103.

Bank rate of discount, 3 per cent. (October 5th, 1898.)

FLUID FUEL.

UNDER the above title Admiral Selwyn, who has, for a long time, identified himself with the liquid fuel question, has read a paper before the Technical Society of the Pacific Coast, in which he makes some very startling claims. Oil alone he considers is capable of evaporating 16·9 pounds of water per pound of oil, this being heavy oil of lubricating quality, having a specific gravity greater than sea water.

The Admiral vouches, in fact, for the statement that every pound of steam used to blow the oil into his furnace produces the full calorific effect of its constituent hydrogen, and brings up the evaporative duty to 22 or 23 pounds per pound of oil and steam burned.

This is, of course, entirely opposed to all chemical knowledge, for hydrogen when burned can only reproduce the heat which was necessary to dissociate it from its combined oxygen. The Admiral, however, proceeds to say that each pound of steam carries with it 214 times its volume of air, of which four-fifths is nitrogen, and this, in the form of nitrous acid "can be shown on the 'highest chemical authority' to be capable, in combination with six atoms of hydrogen, of evolving 329,000 heat units," and he has long ago seen it burned, and burned it himself, under ordinary Cornish and marine boilers, with a result in evaporation of 48 lbs. of water for each pound of oil used, or about six-fold the result now got with coal. This is secured by the *combustion of the nitrogen*, and the Admiral has seen the "apple-green" flame of burning nitrogen in his furnace.

The discussion called forth by this strange paper was, in a sense, mild indeed, but strongly emphatic in pronounced disbelief of the facts put forward without any supporting evidence, one gentleman closing with the remark that "it is unfortunate that the author is unprepared to fortify the statements he has made with data obtained from direct experiments."

It is difficult to understand why Admiral Selwyn should advance such views and statements which, if capable of proof, would imply the greatest discovery ever yet made in practical science. Apparently, the wonderful result is to be had by simply using a steam-actuated oil atomiser to blow oil and air into a furnace so as to impinge upon a refractory block in the entirely brick-lined furnace. Is not this somewhat the procedure of Cavendish himself, the discoverer of nitric acid?

We have not had the pleasure of visiting the Admiral's boiler room in London, but should be most happy to be shown the results which he so emphatically states have been obtained in the presence of engineers. What are we all doing that such results are not universal, when with such simple means an economy of 80 per cent. is to be secured? The writer would like to ask: What is the calorific power of nitrogen as a fuel? That it will combine with oxygen is, of course, undisputed, but to what effect in heat production?

There are five oxides of nitrogen, and even if the Admiral's statement could be proved true, it is doubtful if, on land at least, we could afford to avail ourselves of the power of producing these oxides of nitrogen. The least harmful are probably those which have least calorific power, the most harmful being either nitric acid or becoming nitric acid on exposure to moisture. Unless, therefore, every furnace were fitted with means for absorbing the corrosive products of combustion we should all be liable to rapid disintegration.

The Tarapaca deposits of nitrate of soda are explained by some chemists as the result of nitrification by animal matter of the salt of the dried up sea in which the said animals lived. Are we to hope that the production of manurial nitrates from sea water is to be the process enabling us to produce nitric acid in safety and save 80 per cent. of fuel. If so, why first inform the Technical Society of the Pacific Coast, 6,000 miles away, and why withhold figures and particulars?

But what appears to us to demand explanation in the first place is: Whence is obtained the oxygen with which the nitrogen of an atmosphere, whose composition may be written $N_4 O_1$, is to be converted into oxides whose composition may be anything from $N_2 O$ to $N_2 O_5$. There seems a singular want of oxygen somewhere, and an enormous use of air, with consequent evolution of much heated nitrogen unburned, and we have always understood that the calorific power of nitrogen was small.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.*

(*Continued from page* 460.)

A paper on ELECTRO-MEDICAL ECCENTRICITIES, by H. NEWMAN LAWRENCE, Esq., of London, Eng., in the absence of the author was read by the secretary.

HE first discussed a very common defect of many text books on electro-therapeutics, viz., the apparent lack of connection between the part which treats of electro-physics and that which treats of the therapeutical applications of electricity.

He next suggested that there should be a proper standard of qualifications for medical electricians, and that those so qualified, might with advantage carry out the electrical treatment of cases referred to them by general practitioners. The third topic which received attention, was the existence of so much quackery under the name of electricity or magnetism. The author thought the medical profession should no longer remain silent in regard to so-called magnetic apparatus and appliances dependent for their action upon the well known process of electro-physics, and he suggested that the Association appoint a committee to consider the best way of overcoming these abuses.

The paper was discussed by Dr. Morton and Dr. Herdman, both of whom expressed the opinion that any attempt to overcome such outrages by legislation would produce the very opposite result to that which all desired. It was only by individual effort in the dissemination of correct popular information on medical electricity that we could hope to defeat these quacks.

THE ACTION OF THE CONTINUOUS CURRENT WITHIN LIVING TISSUES AS DISTINGUISHED FROM THE LOCAL POLAR ACTION.

Dr. W. J. HERDMAN, of Ann Arbor, read a paper on this subject. Whenever a tissue is subjected to the action of a continuous current, owing to the fact that the tissue is made up of cells containing fluids and surrounded by cell walls having a greater resistance, these fluids must be absorbed. This is by a process of convection and not of conduction. This theoretical view that electricity must exert a systematic effect is confirmed by experiments made by the author and by others on healthy animal and vegetable tissues. It was found that when these tissues were exposed to a feeble current of electricity for a short time daily, their growth was decidedly increased, but it was retarded by a more prolonged action of the current.

DISCUSSION.

Dr. MASSEY said that the abdominal walls of many patients undergoing the Apostoli treatment for uterine fibroids became the seat of an increased deposit of fat owing to the improvement of the general health consequent upon the treatment.

Dr. MORTON said that the experiments of G. Weiss, the physiologist, in Paris, bore out the point made in the paper regarding electrolytic action and its effect on functional activity of the cells. This investigator passed a strong continuous current through one leg of a healthy frog. After a week it was found that the excitability of this leg was about ten times less than that of the other leg. The speaker said he believed in the polar effect, and believed it reached deeply. Acting on this purely physical view of the action of the electrical current in the human body, he had been in the habit of applying the positive pole to the spine for all spinal cord degenerations, and the negative pole for all inflammations. This was exactly the reverse of the usual treatment, but his experience with this method of treatment had only served to convince him that it was founded on a correct theory.

Dr. HERDMAN, in closing the discussion, said that although many electro-therapeutists did not believe at all in the intra-polar action of the current, he not only believed in it, but considered it very important. By the term "convection" he had meant to convey the same idea as we represent in the expression "progression of the atoms."

OBSERVATIONS ON THE TREATMENT OF GOITRE.

Dr. CHARLES R. DICKSON, of Toronto, read a paper with this title. He now uses Goelet's modification of Apostoli's clay pad, and begins with a current of 10 to 15 m.a. for 10 minutes. The treatment is continued on alternate days, and the strength of the current gradually increased up to 100 or 120 m.a., although in exceptional cases, over 200 m.a. may be used. He considers a strong current applied for a short time preferable to using a weak one for a long time. After the treatment, the parts are sponged off with a cold solution of boracic acid. If after several weeks of this external treatment there is no result, it is proper to resort to puncture. Strict antiseptic precautions are observed, and the puncture is made with a surgeon's needle insulated with several coats of collodion. The puncture should be made, if possible, low down through the isthmus, and during the introduction of the needle the patient should be directed to swallow, so that puncture of the larynx may be avoided. The subsequent punctures are all made at the same spot.

In the cystic form the external treatment is of little use. Here the author advises inserting an aspirating needle, drawing off the contents and filling the sac with a solution of salt in boiled water. The object of this is to make use of an electrode which will fill the deepest

* Abstract of the proceedings of the third annual meeting held in Chicago, September 12th, 13th and 14th, 1893.

recesses of the sac. The aspirating needle is used as an electrode, and after the application the fluid is withdrawn.

In conclusion, the author said that he still maintains that in electricity we have one of the most valuable agents in the treatment of all forms of goitre, and that it is the safest treatment. He had known even external applications of iodine to produce so much œdema that death from asphyxia seemed imminent. Electrical treatment in exceptional cases may have to be extended over a period of two years.

DISCUSSION.

Dr. MASSEY said that some years ago he had succeeded in absolutely curing a cystic goitre which had resisted other means. Four out of six cases of exophthalmic goitre he had completely cured by the external application of a current of 10 m.a.

Dr. MORTON cited one case in which he had succeeded in reducing a very large goitre to one-third its original size by means of the faradic and galvanic currents used simultaneously by a combining switch.

Dr. WALKER spoke of a case in which a lady received such prompt relief from electrical treatment that she would not continue it long enough for a cure to be effected, but preferred to return once each year and receive treatment for about three weeks.

Dr. DICKSON said that in one case where the goitre was large and distinctly fibrous, there was a protrusion of the right eye-ball, which diminished in proportion as the goitre was reduced.

SECOND DAY—September 13th.

MORNING SESSION.

Dr. HOLFORD WALKER, of Toronto, reported a CASE OF ASCITES CURED BY GALVANISM. The patient, a little boy, was treated by galvanism, 39 applications being given. The positive pole was a large clay abdominal electrode, and the negative a large metal disc, which was applied alternately to the shoulders and back every other day for 15 minutes. The patient was unable to tolerate a current of more than 50 to 75 m.a. At the end of three weeks it was evident that the fluid was being absorbed, and in a month or two it entirely disappeared, and since then the patient has continued well, except for a mild attack of rheumatism. Previous to resorting to electricity, all the usual remedial measures had been tried and had failed.

DISCUSSION.

Dr. NEWMAN cited from memory the case of a man with extensive anasarca and ascites, who was brought to him after a number of consulting physicians had expressed the opinion that in spite of treatment he could not live more than two days. Not more than this time elapsed before he measured 3 inches less than before the electrical treatment was begun, and he ultimately recovered entirely. The speaker could not recall the original diagnosis recorded in his case-book. He thought that the treatment caused the withdrawal of some of the fluid, and that it stimulated the secretions.

Dr. ENGLEMAN cited a case of ascites, seemingly just as severe, where two very able physicians gave a similar prognosis. At this juncture some of the patient's family insisted upon calling in a quack, whose treatment consisted in making certain "passes" about the patient. One of the regular physicians continued to call, in order to watch the treatment. The patient immediately began to improve, and during the 10 years which had elapsed since then, she has remained entirely well. In that case microscopical and chemical examinations of the urine confirmed the diagnosis of renal disease which had been made by the physicians originally in charge of the case.

Dr. EUGENE C. GEHRUNG, of St. Louis, thought that an ascites associated with kidney disease was due largely to spasmodic irritation, and that a cure was brought about by the relaxing effect of the electricity on the nervous system.

Dr. J. B. GREENE, of Indiana, said that he had been called in consultation a few months ago to a similar case, where the diagnosis of renal disease was substantiated by the results of the microscopical and chemical examination of the urine; yet to his surprise the attending physician afterwards informed him that from the time galvanism was begun the patient began to improve, and eventually recovered.

Dr. WALKER, in closing the discussion, said that the diagnosis in his case had never been clear. As the boy had been standing daily immersed in water up to his waist, it was possible that the ascites was the result of an ordinary subacute peritonitis, or of tubercular peritonitis, as there was a history of tuberculosis on the maternal side. The kidneys were perfectly healthy.

METALLIC ELECTROLYSIS.

Dr. MARGARET A. CLEAVES, of New York, read a paper on this subject. By this term was meant treatment by inserting in the natural cavities and in the tissues soluble metallic electrodes, such as those made of copper, zinc and iron. Experiments were cited which proved not only that an oxychloride of copper was deposited in the tissues, but that subcutaneous injections of comparatively large quantities of this deposited salt failed to produce in rabbits any toxic symptoms. Other experiments indicated that this copper salt had a more powerful bactericidal action than the ordinary galvano-caustic applications, and that by the cataphoric action of the current, the deposited metallic salt is made to penetrate deeply into the tissues. This is a convenient method of applying a metallic salt in the very depths of the most tortuous sinuses, and it should not be forgotten that the salt so deposited, being in the nascent state, is peculiarly active.

The author stated that for intra-uterine work a current of 25 to 50 m.a. is sufficient when given for 15 minutes, and that then a *reversed* current of 10 or 15 m.a. should be given for six or eight minutes in order to loosen the electrode. However, it should be noted that this adherence of the electrode to the tissues may be avoided by gentle and continued manipulation in suitable localities during the application of the current. Too frequent applications are liable to retard the progress of the case. The work of elimination and repair which takes place in the neighbouring tissues without pain and without inflammatory reaction, extended over a period of eight days. Metallic electrolysis has proved extremely efficient in controlling uterine hemorrhage. The electrodes should be carefully rubbed with emery paper after each application.

Cases were also cited in which the author used metallic electrolysis successfully in uterine fibroma, endometritis, urethritis, granular degeneration of the cervix, hypertrophic rhinitis, trachoma and hemorrhoids. Improvement was observed in most of these cases after one or two sittings, and the cure was both speedy and permanent.

An especial set of electrodes for applications to the conjunctival membrane were presented by the reader of the paper, as well as needles for puncture.

DISCUSSION.

Dr. MORTON said he had proposed the name "metallic electrolysis" instead of "interstitial electrolysis," as used by Gautier, because interstitial electrolysis may occur anywhere where there is a powerful continuous current, even though the electrodes are not metallic. He had been surprised to find in a book written by Butler, in 1876, a very good description of a similar method of treatment, but without any reference to its application in gynæcology.

Dr. Morton then exhibited special forms of electrodes which had been found useful in applying this treatment to the nose, uterus, urethra, and rectum. The adhesion of the electrode to the tissues is particularly noticeable in the treatment of urethritis, and it is probably due to the formation of a soluble albuminate of the metal constituting the electrode. The speaker then cited a case in which he had promptly cured a gonorrhœa of three months' standing, and also the treatment of a cyst on the side of the neck. He also described the action of metallic electrolysis in curing hemorrhoids and atrophic rhinitis, the cure in the latter condition, he thought, being probably due to a restoration of the activity of the few glands which have escaped the destructive process.

Dr. HAYD objected to the treatment from theoretical considerations. He thought it was unduly magnifying the local action of the current, and at the same time encouraging the already too prevalent practice of employing intra-uterine treatment.

Dr. MASSEY said that the objections made by the last speaker did not apply to the *expert* use of intra-uterine applications. We have metallic electrolysis every time we use the galvanic current unless the patient be protected by a very large clay pad to catch the particles of metal which pass off from the metallic conductor. As regards this mode of treatment in connection with hemorrhoids, he wished to state that he had applied a current of 40 or 50 m.a. with a carbon electrode to hemorrhoids, and had seen them reduced by this means, so that it could not be said that metallic electrolysis is essential for such reduction.

Dr. GREEN also objected to this indiscriminate probing of the uterus as unwise and unsafe. He had quickly cured one case of hydrocele by galvano-puncture of the sac with a zinc needle, without withdrawal of the fluid. There had been no relapse.

Dr. P. S. HAYES said that while admitting the dangers likely to follow upon the employment of intra-uterine galvanic treatment in improperly selected cases, he felt that in suitable ones the expert operator could accomplish his purpose much more safely than by the usual topical applications of medicines. It was important to remember that without due regard to the proper technique of metallic electrolysis, it was an easy matter to produce a trauma as a result of the agglutination of the electrode to the tissues. The speaker also emphasised the peculiar powers possessed by metallic electrolysis by virtue of the metallic salts being in the nascent state, and the current carrying them deeply into the tissues. It is probably because of this penetrating action that it has been found so useful in the treatment of gonorrhœa.

Dr. GEHRUNG remarked that this cataphoric action of the current carried along one portion of the medicament before another particle was presented to the tissues, thus preventing a clogging up of the spaces with the medicine.

The PRESIDENT said that he was the first to call attention to the uterine colic excited by cupric electrolysis. Further investigation convinced him that the astringent action of the application tended to constrict the canal and obstruct drainage, and some of the gas which was evolved during the electrolysis did not combine with the metal of the electrode, but remained free in the cavity. By securing better drainage from the cavity by means of previous dilatation, cases which had before suffered from colic, were able to receive the treatment with entire freedom from this unpleasant complication. He knew of nothing superior to cupric electrolysis for controlling the most severe forms of uterine hemorrhage, but for endometritis and granular degeneration of the cervix, he preferred zinc electrolysis. Zinc electrolysis was also useful in promoting the healing and obliteration of the sac of suppurating vulvo-vaginal glands after incision and evacuation of the contents. He had also treated successfully by zinc electrolysis a large keloid involving the anterior surface of the thigh, using 5 m.a. for each zinc needle, for 10 minutes, about 10 or 12 applications being required. He had employed zinc electrolysis also in one case of fibroid by means of vaginal puncture, and had noted that it produced decided softening and marked diminution in the size of the growth.

Dr. CLEAVES, in closing the discussion, said that while she believed a great deal of intra-uterine treatment is unnecessary, she was

satisfied that in certain cases the results from such treatment were quicker and more lasting than from any other. In her own practice, she did not exceed a current of 30 m.a., and oftener used a less current strength.

SOME OBSERVATIONS ON THE FINE WIRE COIL OR CURRENT OF TENSION.

Dr. H. E. HAYD, of Buffalo, read a paper on this subject. He said that his own induction coil consists of 3,500 feet of No. 32 wire, tapped at three points, so as to permit of using lengths of 1,500, 2,500, and 3,500 feet respectively. He had been informed that the vibrator made from 250 to 350 vibrations per second. In securing a sedative action from such a coil, it is very important that the action of the vibrator should be both rapid and smooth. The current from the fine coil may be considered a specific in the relief of that form of neuralgic dysmenorrhœa characterised by tenderness over the ovaries, marked epigastric tenderness, nausea, and vomiting. The treatment is safe and painless, and the current is best administered by means of a simple bi-polar vaginal electrode. These conclusions were supported by a number of illustrative cases.

DISCUSSION.

Dr. A. LAPTHORN SMITH, of Montreal, said that at least half a dozen cases which had not been relieved by laparotomy and the removal of the appendages had come to him subsequently and had been completely relieved of all symptoms by the use of the fine wire current.

Dr. ENGLEMAN said that very vague notions prevail regarding the speed of the ordinary interrupters on induction coils. If the author had used a speed of 350 vibrations per second the patient would not have felt the current. The average vibrator he had found by actual experiment made from 2,000 to 2,400 vibrations per minute, and the best of the old kind of vibrators which he had been able to find in the market—that of Gaiffe—only vibrated 3,000 times per minute, or 50 per second.

(At this point the discussion was interrupted in order that it might form a part of the formal discussion on this subject which had been arranged to take place in the afternoon.)

AFTERNOON SESSION.

DISCUSSION ON THE INFLUENCE OF FREQUENCY OF INTERRUPTIONS AND CHARACTER OF INDUCED CURRENT WAVES UPON THE PHYSIOLOGICAL EFFECT.

Dr. WILLIAM JAMES MORTON, of New York, opened the discussion. He said we possessed three mechanisms for exciting induced currents, viz.: (1) the induction coil; (2) dynamo-electric machines; and (3) condensers, Leyden jars, &c. It has been found that the current with long periods will kill instantaneously, while one with short periods is harmless. The speaker said that in April, 1881, the *New York Medical Record* published an article in which he described a new induced current obtained from the static machine. His conclusions were: That the current possessed great diffuseness; that it produced an analgesic effect; (3) that it produced a vaso-motor effect, manifested by dilation of the superficial blood vessels and the occurrence of perspiration; and (4) that it caused an elevation of the body temperature. His mechanism, then published, is the fundamental electrical mechanism necessary to produce the high frequency high potential currents now so thoroughly familiarised by the labours of Tesla, Elihu Thomson, and D'Arsonval.

In February, 1891, Tesla published his first article on high frequency currents. In this article he made the statement that the writer's experiences tend to show that the higher the frequency the greater the amount of electrical energy which may be passed through the body without serious discomfort.

About the same time Elihu Thomson was investigating the same subject. He found: (1) that the higher the frequency, the less the effect on an animal; (2) that the cause of pain lies chiefly in the muscular contractions produced; (3) that the cutaneous nerves were less painfully affected at a higher rate; (4) that the visual mechanism was not excited at a higher rate, even with a pressure of 15 volts.

D'Arsonval's conclusions were: (1) That the high frequency current had no effect on the organs of feeling; (2) that it produced no muscular contractions; (3) that there was a diminution of the sensation of pain; (4) that there was a dilatation of the blood vessels; (5) that it caused an increased perspiration; (6) that it caused increased tissue change, manifested by increased absorption of oxygen and increased elimination of carbonic acid; and (7) that it caused no increase of body temperature.

Dr. MORTON then exhibited a medical induction alternator affording a sinusoidal current, which Mr. A. E. Kennelly had constructed at his suggestion. It gave a current having 1,200 periods per second.

The discussion was continued by a communication from A. E. KENNELLY, Esq., of the Edison Laboratory, entitled INDUCTION COILS.

In his absence the paper was read by Mr. E. M. SMILES. The author began by giving a strictly technical description of the magnetic laws involved in the working of induction coils. Observation shows that the primary current does not instantly reach its full value, but there is developed in the primary coil an electromotive force which is always in opposition to that of the battery. This is called self-induction. As soon as the vibrator spring leaves the contact point, the metallic circuit is broken, but not instantly, for there is induced a secondary flux in both the primary and secondary coil, and in such a direction as to sustain the battery current. The duty of the faradic coil is to supply a certain strength of alternating current at a given frequency. Probably no two coils give precisely the same wave characters; long coils and many windings produce smoother flowing and less abrupt waves. The ordinary form of spring vibrator rarely supplies more than 250 vibrations per second, while the ribbon spring easily makes 1,000 vibrations per second; but both are very irregular. If a current of 5 m.a. be supplied by an ordinary faradic coil at 250 alternations, there will be much uncertainty as to the wave characters, but if the primary be excited by a sinusoidal current of the same frequency, the character of the waves can be accurately determined.

A communication from Prof. EDWIN HOUSTON, of Philadelphia, entitled REMARKS UPON APPARATUS TO PRODUCE INDUCTION CURRENTS, AND THE CHARACTER OF THE WAVES OF INDIVIDUAL APPARATUS, WITH ESPECIAL REFERENCE TO THOSE APPLICABLE TO MEDICAL USES, was read by Dr. MORTON in the absence of the author.

Reference was made to the remarkable change in the physiological effect which resulted from a change in the frequency of the interruptions of the current. The harmlessness of the high frequency current is probably due to the fact that it is unable to reach the deeper organs; for if the effect of the discharge on a bar of solid copper is very superficial, the effect on the human body must be still more superficial.

Dr. J. H. KELLOGG, of Battle Creek, continued the discussion in an article entitled THE GRAPHIC STUDY OF ELECTRICAL CURRENTS IN RELATION TO THERAPEUTICS.

Dr. KELLOGG said that he thought thus far in the discussion two or three different forms of current had been confounded, for the rapidly interrupted current is not a sinusoidal current. He first described this current in a paper read before the American Medical Association in 1888. The effects obtained from it varied with the speed of the machine. When only 15 or 20 alternations were made per second, it produced vigorous muscular contractions with complete relaxation at each alternation. The sensory effects are best obtained by giving the machine a high velocity; under such circumstances it will be found that if the electrode be placed in the region of the eye, the subject will perceive a luminous field which varies its position with that of the electrode.

He had made more than 20,000 applications of the sinusoidal current, the greater number being in gynæcological cases, and with it he had been enabled to cure hundreds of women who had previously suffered many things at the hands of gynæcologists. The current is chiefly useful: (1) In exercising muscles which are not easily brought into action by voluntary effort; (2) for producing muscular contraction in cases where degenerative changes have advanced so far that the muscles fail to respond to the faradic current; (3) in connection with "the rest cure" for giving exercise to feeble patients. Here it is superior to the faradic current, on account of the painlessness of the contractions and their greater vigour. The application is also more easily made, as it is not necessary in most cases to locate accurately the motor points. (4) It is very valuable when used alternately with massage. (5) It is of the greatest advantage in strengthening relaxed abdominal muscles, which are after responsible for displacements of various abdominal viscera, and the occurrence of various reflex symptoms. (6) For the treatment of hyperæsthetic conditions of the nervous system. Here it is necessary to employ an extremely delicate rheostat, and to use the current obtained from the machine while at a high speed. In marked contrast with the faradic current, he had found no idiosyncrasy to the sinusoidal current.

He believed the rheotome was a fatal element of weakness in the induction coil, and that this well known instrument is inherently faulty as an agent in electro-therapeutics. Nothing but the graphic method would enable the medical practitioner to regulate a faradic apparatus so as to obtain exactly the same current at all times, and he predicted that the faradic apparatus would have to give place to a more reliable instrument.

(*To be continued.*)

THE INTERRUPTED ATLANTIC CABLES.

THERE appears to be a disposition in some quarters to construe that portion of the Marquis of Tweeddale's remarks at the last meeting of the Anglo-American Telegraph Company, with respect to the condition of two of the cables belonging to the company, as being applicable to submarine telegraphy in general. There is really no ground, says the *Railway News*, for the hasty assumption that the imperfect condition of the cables referred to afford evidence that the life of a perfect and well constructed cable is of briefer duration than that which the general experience of the last quarter of a century has assigned to it. The cable which is now, and has been for years past, a source of trouble and expense, was one of the class which numbered many faults and failures. It was tainted with the original sin of bad and imperfect construction. It was designed on the Hooper principle, and from the first hour of its existence to the present day it has never enjoyed the blessings of a sound and healthy constitution. Before the line was completely laid between Brest and St. Pierre a fault was discovered which prevented messages passing through the submerged portion, and after this difficulty had been discovered and the line was laid, its working had been constantly interrupted, and contractors and concessionaires stood ready with £40,000 of reserve shares to remedy the defects in construction. As stated by the chairman at the last

meeting, this French cable has cost the company during the 20 years it has been worked by them not less than £240,000—a sum which, owing to improvements in the manufacturing processes and greater experience, would represent more than one-half of the cost of a new cable to Newfoundland.

The French cable was originally projected as a competitive scheme to the original Atlantic Telegraph, and some of its promoters were largely engaged in a speculative "deal" in Atlantics. When first projected ocean telegraphy had not then become a necessity of the day, and all the messages offering were sent over the two existing cables without difficulty. The cost of a message of 10 words had been reduced from £20 to £5 5s. Sir James Anderson stated in his "Statistics of Telegraphy" that one cable would have sufficed for the whole of the traffic, the capital and expenses of the French Atlantic Company would have been saved, and the Anglo Company would then (1872) have been enjoying 27 per cent. of dividend upon a capital of £1,675,000, this capital including the whole amount which had been lost in connection with the abortive attempts to lay the cable in 1858.

The French company was formed in 1868 with a capital of £1,200,000 to lay a cable from Brest to St. Pierre in Newfoundland, and thence from St. Pierre to Duxbury, near Boston. The main line was 2,584 miles, and the Duxbury branch 749 miles in length, the total length being 3,333 miles. A connecting cable was also laid from Seacombe on the Devonshire coast to Brest. The promoters of the scheme were paid £100,000 for the transfer of the concession from the French Government for laying and working the telegraph between France and the United States for 20 years from September 1st, 1869. The concession from the French Government proved to be of no value as conferring any rights or privileges within in the United States. Before the final link between St. Pierre and Duxbury had been laid, Mr. Secretary Fish notified to Sir Edward Thornton, our Minister at Washington, that his Government could not recognise any right to land cables on United States territory without the consent of Congress, and further directed attention to the bill passed by the Government specifying the conditions upon which such permission should be granted, and which included among others equal rights with any other foreign government over such cables; priority in use of the lines at rates to be fixed by the Postmaster-General; lines to be opened to the public for all messages in the order of their receipt; and Congress to have the power to fix the rates to be charged. As a result the French Government was released from its concession, and the Government agreed to hand over to the company all messages at equal rates not marked to go by any other route, and gave to the French company permission to amalgamate with any other company. On an ill-fated day, the Anglo-American, pressed by the clamours of a section of its shareholders, and aided by a powerful clique of outside speculators, gave effect to this permission, and the French and English companies were amalgamated on the basis—which at the time was severely criticised as being too favourable for the rival line—of dividing gross receipts in the proportions of $36\frac{2}{3}$ to the French, and the balance, $63\frac{1}{3}$, to the Anglo company.

From the first inception of the French scheme it was intended that the contract for making and laying the cable should, if possible, be secured for a company which had purchased a process of construction patented by Messrs. Hooper. The system adopted by the Telegraph Construction Company—which represented in effect the firm of Glass, Elliott & Co., the constructors of the first Atlantic cable—and which had the benefit of the great engineering experience of Sir Daniel Gooch—was ignored, and the Hooper process was adopted for the construction of the rival cable, with the result of a cost to its present owners, as already stated, of £240,000 on a cable which has long since ceased to be of any practical value, and has added its 3,000 miles to the many leagues of what a correspondent describes as "Hooper's short-lived core," which "the dark unfathomed caves of ocean bear."

Proprietors of Anglo-American stock may derive some encouragement from the fact that the cable which has ceased to be operative is not one upon which estimates of the longevity of submarine cables can fairly be based, and the failure in this particular case should not operate as a discouragement in the great enterprise of ocean telegraphy.

NEW PATENTS—1893.

19,378. "Improvements in electrical cooking and heating apparatus." G. BINSWANGER. Dated October 16th.

19,410. "Improvements in electrical fittings also applicable to other purposes." A. FIRTH and G. Y. ASHWELL. Dated October 16th. (*Complete.*)

19,418. "Improvements in the manufacture of wire ropes, electric, and other cables." J. T. WILLIAMS and G. J. MAY. Dated October 16th.

19,423. "Improved continuous electric current distributing system." M. VON DOLIVO-DOBROWOLSKY and ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT." Dated October 16th. (*Complete.*)

19,427. "Improvements in electro-motor toys." R. MYERS, W. BURWELL, and W. A. GRIFFITHS. Dated October 16th.

19,465. "Improvements in systems of electric distribution." C. A. ALLISON. (Communicated by C. O. Mailloux and W. S. Barstow, United States.) Dated October 17th.

19,515. "The application of tinsel cord in the manufacture of candle shades, electric light shades, and candle sockets." E. GUTTENTAG. Dated October 17th.

19,529. "Improvements in automatic central telephone switch apparatus." F. NISSL. Dated October 17th. (*Complete.*)

19,534. "Improvements in and relating to electric light switches and wall plugs." G. DAVIS. Dated October 17th. (*Complete.*)

19,542. "Improvements in apparatus for the electrolytical decomposition of salt solutions." C. KELLNER. Dated October 17th.

19,599. "An improved shade for oil, gas, electric, or other lights." J. F. HOYNE and G. R. STODDART. Dated October 18th.

19,614. "An improvement in secondary battery plates." W. JEFFERY. Dated October 18th.

19,625. "Improvements in glass bulbs for electric lamps." M. WILLIAMS. Dated October 18th.

19,676. "A new electric arc lamp." E. TORRINI. Dated October 19th.

19,688. "Improvements in safety appliances to be used in connection with electrical decomposing apparatus." J. C. RICHARDSON. Dated October 19th.

19,759. "Improvements in dynamo machines." F. W. LANCHESTER. Dated October 20th.

19,765. "Improvements in electric switches." J. L. DURWARD. Dated October 20th.

19,784. "Improvements relating to the manufacture of incandescent electric lamps, and in apparatus to be used therefor." C. J. P. ROBERTSON. Dated October 20th.

19,789. "Improvements in electric railways." S. PITT. (Communicated by the Universal Electric Company, United States.) Dated October 20th. (*Complete.*)

19,791. "Improvements in or connected with electrolytic cells." F. HUBTER, H. AUER, and E. K. MUSPRATT. Dated October 20th.

19,809. "Improvements in carbons for electrodes and other purposes." H. Y. CASTNER. Dated October 20th.

19,831. "Improvements in governors for turbines and other motors." E. H. RIETER. Dated October 21st.

19,850. "Improvements in tools applicable for use in putting up electric light fixtures and for other purposes." C. BISHOP. Dated October 21st.

19,851. "Improvements in or appertaining to the hearing end of receiving telephones, speaking tubes, and the like." W. P. THOMPSON. (Partly communicated by G. V. Benjamin, United States.) Dated October 21st.

19,857. "An appliance for arresting induced electric currents of high potential." W. C. JOHNSON and L. J. STEELE. Dated October 21st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

9,108. "Improvements in or connected with electric batteries." C. P. SHREWSBURY and J. L. DOBELL. Dated May 13th. The inventors employ sheets, cylinders, plates, or blocks of carbon or coke, as the dissolving electrode, but, in lieu of employing plates or surfaces of iron as the non-dissolving electrode, they substitute therefor a hollow and perforated or porous plate, cell, or chamber, which they pack with any suitable metallic oxide, such as the oxides of the following metals:—Manganese, iron, cobalt, nickel, barium, lead or copper. 2 claims.

10,696. "An improved cover for electric push knobs and the like." A. SHIELS. Dated June 4th. The improved cover is made in two parts, the base part being made with a bayonet joint or joints, and with a spring catch or stop. The top part, in which the window may be secured, has suitable projections which fit into the joint or joints of the base part. 1 claim.

10,735. "An improved process and apparatus for the production of sodium, potassium, and like metals by electrolysis." H. C. BULL. Dated June 7th. The chloride under treatment is melted in a furnace, it being contained in a suitable vessel, or in a number of these vessels, suitably arranged in the furnace. The vessel for reducing the chloride is covered and is separated or divided into two parts or chambers by means of a sleeve, within which is placed a porcelain lining. This sleeve descends some distance into the melted chloride and keeps the metal and chlorine produced by the electric action from combining after they have been so produced. Within one of the said chambers bars of iron—suitably held in position—are placed, and from which they can be removed at will, while within the other chamber, bars of carbon are placed, the carbon and iron bars being separated from each other by suitable insulating material, and insulated from the vessel and cover. 6 claims.

10,873. "Improvements in electrical indicator apparatus." C. A. MCEVOY. Dated June 8th. This invention has for its object to provide apparatus by which variations produced in an electric circuit by the action of a microphone may be made to give warning of the approach of a vessel. 3 claims.

10,876. "Improvements in the reflection and distribution of the electric light." I. A. TIMMIS. Dated June 8th. Consists in shading the electric light, arc or incandescent, by grinding or dipping the glass bulb or shade or in any suitable or convenient way, and in putting a glass mirror or reflector above or at the back of the lamp. 1 claim.

10,999. "Improvements in electric clocks." A. B. WEBBER. Dated June 11th. The clock is set in motion in the first instance by a swing of the balance wheel, and thenceforth is driven by the balance wheel by means of a spring which engages the teeth of the escape wheel at every complete vibration. An electro-magnet, which

may be of any convenient form, is fixed on the movements of the clock, and is connected with the battery and with contact springs. The contact springs are fixed on the movements of the clock, and being set at an angle and not parallel to each other, touch each other obliquely. 2 claims.

11,194. "Improvements in indicating apparatus for high tension circuits." B. M. DRAKE and J. M. GORHAM. Dated June 15th. Relates to further improvements in indicating apparatus for high tension circuits described in patent 4,053, of 1890. In order to enable the absolute insulation resistance to be determined, they provide a high resistance of known value which they connect permanently to earth, and they connect to this a two-way switch by which means they can put first one, and afterwards the other of the leads to earth through the known resistance. 3 claims.

11,624. "Improvements in coin-operated telephone apparatus." H. H. LAKE. (Communicated from abroad by E. Noriega, of Mexico.) Dated June 21st. Consists in the combination with the coin chute of a mechanical circuit-closer operated by the weight of the coin, and coin-releasing mechanism worked by an electro-magnet controlled by the central station. It also consists in means for returning the coin to the depositor in case service cannot be rendered. 5 claims.

11,634. "Improvements in or relating to electric railways." F. WYNNE. Dated June 21st. The inventor constructs each of the road contacts, which are arranged longitudinally of the road, one behind the other, and are normally disconnected from the insulated main conductor of electricity, with a longitudinal groove or channel in its foot or base in which is arranged the main conductor, and also if desired the subsidiary conductors employed for connecting the rails with each other through a contact-making device. These rails are laid upon blocks of comparatively cheap and fairly good insulating material, such as bitumen concrete, arranged within a longitudinal trench formed in the concrete or other road bed, and are then insulated by insulating material, such as rich or more easily melted bitumen, which is poured or pressed into the trench above the said blocks so that the said rails, excepting their upper surfaces, will become firmly embedded therein. The pavement or roadway is also preferably made up or laid in asphalte or bitumen. 8 claims.

11,822. "Improved electrical means or mechanism for driving clocks and other mechanism." H. ARON. Dated June 24th. Relates to improved means for electrically winding up the weight employed to drive a clock, or clockwork or other mechanism. 1 claim.

12,122. "Improvements in microphone mechanism." C. A. McEVOY. Dated June 29th. Have mainly for their object to improve the construction of microphone mechanism, either to be submerged in the open sea or channels wherever it is desired that notice should be given of any vessel passing near to the spot where the mechanism is submerged, or to give warning of the passage of troops when used on land. The inventor uses a bell or casing, open at the bottom, but closed at the top. To the inside of the top of the casing he causes a light frame to be held up by springs; this frame carries the flexible diaphragm and contacts of the microphone. 4 claims.

12,311. "Improvements in electric theft-prevention alarms." C. DARRAH and T. J. GOUGH. Dated July 2nd. A circuit-closing device is held open by the weight of the article held by or suspended from the holder, so that so long as the article is in its place, the electric circuit remains open; but immediately upon the weight of the article being reduced or removed, the circuit is closed, and an alarm is given by means of an electric bell or otherwise. 1 claim.

12,382. "Improvements in the manufacture of wire, strips, and the like by electro-deposition." R. D. SANDERS. Dated July 4th. The inventor places the insulating material so that the metallic surface on which the deposit is made is not the full width of the bottom of the groove whereby, as the deposit grows, the side clearance spaces will allow the strips to broaden as the thickening proceeds. 2 claims.

12,528. "Improvements in telephonic apparatus and switches." G. L. ANDERS and W. KOTTGEN. Dated July 7th. Consists in a circular switch contained within the microphone case, or mounted upon a circular base carrying the microphone for connecting and disconnecting any one of a number of outlying stations, or for connecting with each other any two of these outlying stations as may be desired. 2 claims.

12,665. "Improvements in the formation of plates or electrodes for secondary batteries." G. GARASSINO. Dated July 9th. The inventor immerses lead plates in a bath of hot caustic potash, dissolved in distilled or rain water, furnished with anode and cathode plates connected to a dynamo, or other source of electricity, and with a layer of litharge in the bath. The resulting peroxide is caused to assume the hard crystalline form by emersing helical leaden grids in dilute acid, nitric, and then applying the paste, which treatment brings about crystallisation. The plates are then subjected to pressure, and charged to saturation in a bath of hot dilute sulphuric acid. 2 claims.

12,737. "Improvements in electrical switches." T. JENNER and G. B. WILKES. Dated July 11th. Claims:—1. An electrical switch, consisting of a double armed spring-like piece, capable of being rotated around a vertical axis in combination with a rose or base of insulating material, having two sloping raised faces of conducting material, which are connected to the terminal screws and against which the ends of the aforesaid piece can make contact, substantially as set forth. 2. An electrical switch consisting of a double armed piece having slitted or brush like end parts, and fixed on a boss or sleeve with a key, which sleeve can be rotated on a pillar fixed to a rose.

12,999. "Improvements in the method of and means for distributing electric currents." G. KAPP. Dated July 15th. Consists in providing methods of and means for cutting the transformers out of, and putting them into action, from the central station, and for ascertaining at that station whether any particular transformer at any sub-station is or is not connected with the feeders and distributing circuits. 4 claims.

13,207. "Improvements in incandescent electric lamps." L. STERN. Dated July 19th. The object of the invention is to provide a new and improved socket for incandescent electric lamps, which socket is provided with a switch, so constructed that in order to turn the light on or off, it is only necessary to pull downwards a cord or chain connected with the switch lever. 8 claims.

13,473. "Improvements in apparatus for heating purposes and cooking by means of electricity." G. BINSWANGER. Dated July 23rd. The chief object of the invention is to provide an insulating and refractory material to cover, and partly or wholly surround the conductor or the articles or vessels to be heated, or to radiate or diffuse heat. 3 claims.

13,358. "Improvements in or relating to regulating alternate current circuits." W. M. MORDEY. Dated July 21st. Relates to the use of an "equaliser," which apparatus consists of coils of wire or other suitable conductor, arranged in the fashion of a transformer, preferably with iron so disposed as to assist the action. The windings or connections are so arranged differentially that when the currents flowing in the two (or it may be several) portions of the parallel circuits are equal (or it may be proportionate), the coils of the equaliser exert no influence upon each other, the magnetism being *nil*. But in the event of one portion being stronger than another, the equaliser establishes a balance between the circuits, more or less complete according to the proportion borne by the equaliser to the effect sought to be corrected. 1 claim.

13,381. "Improvements in the manufacture of electrical storage plates." E. B. BRIGHT and L. W. MERCIER. Dated July 22nd. The inventors use either a series of threads or strings or belt of woven fabric or net, of a material which is non-combustible at the temperature of molten lead, as the foundation upon, and into the interstices of which, lead is to be passed or pressed. 5 claims.

13,507. "Conduits with insulators for underground conductors for the distribution of electricity." W. H. SCOTT. Dated July 25th. Claim:—Conduits with insulators (for underground conductors for the distribution of electricity), consisting of lengths of glazed earthenware pipe with insulators or insulated bearers of vitrified or glazed earthenware, or equivalent material, secured in or between the said lengths of pipe, and having passages with conical splayed or rounded terminations for the conductors, and an opening or openings for the passage of water along the lengths of pipe, substantially as described and illustrated.

14,160. "Electric apparatus for working the elevating and training gear of guns and the lifts for their ammunition." G. S. GRIMSTON. Dated August 5th. The principal object of the invention is to cause automatic stoppage of the motor which performs the work when the movement has attained definite limits. 2 claims.

14,250. "Improvements in secondary batteries." S. A. ROSENTHAL and V. C. DOUBLEDAY. Dated August 6th. The active material is held in a perforated and corrugated piece of sheet lead forming the conductor, so that the material on both sides is keyed together by the said material itself in the perforations. This plate is contained within a frame of ebonite or other suitable non-conducting material, such frame being of about the height or thickness of the corrugated plate. The frame is on both sides covered by a perforated lid of ebonite, or other suitable non-conducting material, the lids and the frame being held together, for instance, by through rivets, or in any other suitable manner so as to form a closed box containing the plate. The frame is formed with a recess for the plate tang to pass out. 2 claims.

14,256. "Improvements in cable connection for lightships." H. A. C. SAUNDERS. (A communication from abroad by R. Greey, of Malta, and W. H. Cottrell, of Syra.) Dated August 6th. Claims:—1. A swivel coupling, substantially as described, suitable for a lightship's mooring, and adapted to receive into it the ends of two electrically connected cables in such manner that the one may rotate relatively to the other without interfering with the electrical continuity. 2. A cable connection for a lightship, substantially as described.

14,647. "Apparatus for controlling the electric current on putting electro-motors in circuit." SIEMENS BROS. & Co., LTD. (Communicated from abroad by Messrs. Siemens & Halske, of Berlin.) Dated August 13th. Claim:—Apparatus, for controlling the current supplied to an electro-motor, wherein two carbon electrodes, maintained in contact by gravity or equivalent means, are combined with a wire coil or solenoid and an iron core, all being included in the circuit of the electro-motor and current generator in such manner that when the current of full strength passes through the coil and electrodes before the electro-motor has been started, the coil will be made to move the electrodes momentarily out of contact, thus either weakening the current passing to the motor, or momentarily breaking the circuit entirely for a time, such making and breaking of contact being repeated until the motor has attained its normal speed, substantially as described.

23,967. "Improvements relating to reflectors for electric arc lamps." H. H. LAKE. (Communicated from abroad by C. Coerper, of Cologne.) Dated December 28th. Claim:—In electric arc lamps the arrangement of reflectors directly above the arc, in combination with glass globes which are open at the top and are smaller in diameter than the said reflectors, substantially as and for the purpose specified.